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THE

SURGICAL AND DESCRIPTIVE

ANATOMY

OF THE

BONES, LIGAMENTS, AND JOINTS.

By W. H. THOMAS,

MEMBER OF THE ROYAL COLLEGE OF SURGEONS, LONDON.

LONDON:

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TO

HENRY RILEY, ESQ., M. D.

AND

HENRY CLARK, ESQ.,

LECTURERS ON ANATOMY AT THE BRISTOL SCHOOL OF MEDICINE,

THIS BOOK

IS DEDICATED, BY PERMISSION,

AND AS A TESTIMONY OF RESPECT AND ESTEEM,

BY THEIR SINCERE FRIEND,

THE AUTHOR.

TO MEDICAL STUDENTS.

GENTLEMEN,

IN the perusal of this Work you will discover whether the arrangement here adopted can afford you that assistance in the study of Osteology, which I conceive it may. Personal experience of its value in my own education, and in that of many professional friends, may not be received as impartial evidence. To you, then, who shall be both witnesses and judges, do I refer it as to a competent tribunal: and I scarcely need say, I care not how many compose the bench.

Novelty forms a very small share of its merits: for setting aside the difficulty of producing any thing new in such a science as this, I would not be thought to affect it if I could; from the conviction that it is of itself but a poor commendation at the best, and a circumstance both in manners and opinions for the most part better hidden than pretended. Neither have I hazarded a new nomenclature: considering the old one — that in which a pupil is instructed and that in which he will hereafter be examined — far better for the purposes designed, than one more accurate or modern. A system somewhat similar to that here advanced, was formerly taught by the celebrated MONRO, whose work on the Anatomy of the Bones contains the elements of that science written with an accuracy and point worthy the pen of so great a man. In addition to others who have followed

a similar system, may be mentioned the late MR. BROOKES, whose celebrity as a teacher is the best proof of the worth of his instructions.

The peculiar merit of this system, consists not only in connecting together leading principles in the three sciences of Anatomy, Surgery, and Physiology, where their association may be made without violence to these subjects or too great stress upon the memory of the student in maintaining the connection; but also, more especially, in combining the links in the chain of anatomical facts—in shewing the contiguity and appropriation of one system to another, and above all, of the osseous or basal, with the softer structures surrounding it. This I conceive to be an essential good—a work which the student must accomplish by his own efforts, in a great measure, and one in which he requires, and should possess, every assistance.

In conclusion, I must request your indulgence in correcting by the table of errata the literal errors which unfortunately have remained during the progress of the Work through the press, which being chiefly of Latin and Greek derivation, may otherwise cause you some confusion.

I remain, Gentlemen,

With much respect,

Your most obedient Servant,

WILLIAM HEARD THOMAS.

St. Mary's, Redcliff,

June, 1834.

THE

SURGICAL AND DESCRIPTIVE

ANATOMY

OF THE

BONES, LIGAMENTS, AND JOINTS.

OSTEOLOGY, ETC.

INTRODUCTORY LECTURE.

Osteology teaches the existence of animate and inanimate* matter in a state of combination, in the form of an organized bone; treats of its mode of organization; and of the uses to which it is applied.

In taking a cursory view of created things, one of the first facts which strikes our attention is, that very generally, animated nature is fixed to or upon inanimate. The truth of this is borne out as certainly, whether we adduce as instances the polypus or the shellfish on the one hand; or, on the other, man himself, the "lord of the creation;" for although the difference which exists, in reference to this fact, in these several animals and their modes of being, is certainly very material in other re-

* See the explanation of this in the concluding remarks of the Lecture.

spects, inasmuch as the latter, with the major part of the animal kingdom, possess, superadded, the power of *locomotion*, which lifts them higher in the scale of being above those which are fixed immoveably on a rock, or in the earth, for the term of their natural existence:—yet, notwithstanding, these moving animals also must possess a *skeleton*, the principal constituents of which are *earthy*, and thus form an inanimate basis, to which the living structures are appended, in point of fact, just like so many primitive polypi in their individual fibres, but in their aggregate combination forming compound and sensitive animals.

For the sake of arrangement then, after making the general statement that bone is constituted of *hard inanimate structures of different degrees of density*, and compounded of various earths and salts; and of *soft structures of different degrees of vitality;* we will proceed:—I. To a more particular *consideration of these two grand constituents.* II. To their *process of combination* or *mode of formation;* and, III. We will point out the *diseases bones are subject to, from the nature of their organization, and liabilities to change of structure.*

I. OF THE CONSTITUENTS OF BONE.

If we place a bone in the hands of persons unacquainted with the science of Osteology, they will be enabled from observation to describe it as a *hard, compact, inflexible substance*, of a *whitish colour*, appearing to be composed of *earthy matter*, held together by an organized bond, and dis-

posed into a variety of different arrangements of structure. One person will describe it as *striated* in construction; another, as *cellular*; and a third, as *lamellated*; and they will each say truly, for all these varieties of arrangement exist in the bones of the skeleton. But, a man skilled in that science, will superadd to this statement an analysis of the constituents, entering into the formation of this compact and inflexible structure:—he will thrust the end of a bone into the fire, and, by the process of calcination, rob it of its organized bond, and then crumble between his fingers the pure white earthy matter remaining, which will be found to be chiefly *phosphate of lime*:—or, he may produce a bone acted upon by the diluted muriatic acid, wherein it has been immersed for a season, and bend it into a knot, because the earthy particles have been solved by the acid, and the residue is the animal structure of the bone, the *cartilage, gelatine*, and *cellular membrane*. As however, on the one hand phosphate of lime is not the exclusive although the most extensive earthy constituent, but is combined with *carbonate of lime*, and *salts of soda*; so on the other we have many substances termed animal, entering into the formation of the organized part, which are not resolvable into either of these three general terms; thus we may find *fat*, or *medullary secretion*, the component parts of the *blood*, etc.*

* And various *extraneous substances*, such as madder, and other colouring vegetables, if they have formed the food of the animal for some time previous to its death.

These two grand constituents will not be found to have kept their parallel in the formation of the bone at all ages of human existence; for in childhood, the animal, and in old age, the osseous constituents predominate. At that happy period when the balance is kept with an even hand,—when man may be said to have arrived at a maturity of growth,—when all the faculties and organizations of the various viscera are full of vitality and energy,—then may it be said also that there is a just disposition of the animal and earthy constituents of bone, as well as of all the structures of the human frame: but it is then with man as with the tide of a river, the impetus of its flow has been checked, it has arrived at its utmost height; it remains stationary for a moment, in all its beauty and magnitude, and then ebbs almost as rapidly as it had flowed.

So man is a changeable being; to day, he may be strong and powerful—to-morrow, spent and emaciated. That man yonder, who is bent with age, the vicissitudes of which have scarcely left mind enough to conceive a thought foreign to the immediate sense of his animal wants,—who scarcely has strength enough remaining for any other effort, than to put his food to his lips, or lay his shrunken frame upon a couch;—he, in the middle age of his existence, stood upright, a man full of vigour of intellect and nerve of body;—and he, also, in the first extreme of his life, lay at his mother's breast, helpless, and endued only with power to draw the vital stream therefrom, under the im-

pulse of animal instinct: indeed, it has often occurred to us, that *perpetual motion* would never be better illustrated, than in the vicissitudes which matter experiences in the human body, were it not that for it also the grave calls; even in which, however, though imprisoned, it knows no permanent rest; for, as one relative follows another into the family inclosure, each successive one is surrounded with the mouldering relics of its older inhabitant, and those of whom a father might have said, they were "bone of my bone and flesh of my flesh," will, when that generation has passed away, become kindred dust, united in an undistinguishable commixture.

This may be melancholy matter enough for a poet to exercise his genius upon, but it is of infinitely more importance to a physiologist, to whom these changes appear full of interest, as affording a large field for profitable consideration: this brings us to our second division.

II. OF THE GROWTH, DEVELOPMENT, AND FORMATION OF BONES.

Now to treat of the formation of a bone, we must look at the embryo, in the uterus, which contains the elementary principles of every structure of the system, when scarcely any member is perceptible, rising into form in its homogenous substance.

After the heart and the brain have been distinctly visible, then, and not till then, *capsules of gelatinous substance* are perceptible, which become the

nidus for the deposition of *cartilages* which represent the future bones. In course of gestation these cartilages become developed in size corresponding to the proportions of the fœtus at large, assume a shape similar to that which the future bone is to possess, and gradually become perceptibly vascular. At length, a deeper blush of vascularity reddens the centre of the cartilage, and the vessels deposit a nucleus of bone, which becomes the point of radiation of bony striæ in a *flat*, of cellular depositions in a *short*, and of parallel ramifications in a *long bone*;—intertexture of bony substance then fills the interstices between the fibres, and *lamellæ*, or *plates* of bone, are formed; these are successively increased by the internal arterial action, (and not by the periostium forming lamina upon lamina excentrically to each previously perfected circle, as formerly supposed,) and their latitude increased by constant deposit, until either the extremities of these new formed portions of bone meet with the extremities of others, and the cartilage between is absorbed, which was their bond of union, and bony substance is deposited in its place, making the two portions one bone;—or else, they proceed to form the connection between two separate bones, by some alteration of the disposition of its fibres, as is the case with the sutures of the skull; or cease their deposition under the influence of the fixed laws of nature, and give the soft structures power to form joints.

Let us take an example of a *flat* bone, and see the mode of its formation. We describe then the

parietal, which is one of the best instances of a flat bone: like most flat bones, this has to do with the *formation of a cavity*. This bone is placed between the membranes which line it, the one externally, the other internally; between these two, processes of cellular substance extend, having vessels in their structure, which secrete a gelatinous matter, by which the general form of the bone is obtained; commencing in the centre of this substance a partially *reticulated** deposition of bone is produced, and the gelatine proportionately absorbed; this reticulated, soon assumes a striated structure, the fibres of which, shooting from the centre to the circumference in a radiation, permanently retain the shape of the bone; this radiation of fibres thus commencing at the most convex part, and extending to the circumference, becomes gradually denser, in the same manner as it was originally formed, and completes the *tablea*, — whilst the *diplöe* is a product of later date, the immediate result of intersticial deposition and absorption.

Let us now look at a *short* bone. We will instance a *bone of the tarsus*: in the first place, it is altogether cartilaginous; then, a nucleus is formed in its centre, around which, cellulæ of bone quickly accumulate until it becomes osseous to its surface, when, by the process of secretion of bone, the absorption of cartilage, and the uniform action of the periosteum, the surface is hardened and encased with a lamella of denser structure and of variable thickness.

* Scarpa.

In a *long bone* it is not precisely the same; for if we instance the *femur*, the longest and best example of the *cylindrical*, we see longitudinal fibres of bone intersected by a cellular intertexture, forming laminæ which are arranged *concentrically*, the most exterior being the denser, and the internal being promiscuously thrown into *spiculæ* and cells, which are more or less spongy in structure, and are termed *cancelli*. Thus much for the shaft. Now the *head*, the *trocanter major*, *trocanter minor*, and the *condyles* of this bone have separate centres of ossification, from which as in a short bone, cellulæ of bony substance spread toward the circumference, supplanting the cartilages, which are reabsorbed into the system, and these portions of bone ossify down to the cartilaginous interstices which separate between them and the shaft, which gradually extenuate until these separate parts of the shaft become one bone. *Epiphyses*, is the term applied to these separate parts, which they retain until they are combined as above described. By the term *apophysis*, is described a process of bone which does not owe its formation to a separate centre of ossification, but is eked outwards by the shaft of the bone from its extremity or on its surface.

We have now followed the bone in its formation from its gelatinous to its cartilaginous, and lastly to its perfect state; and we will in passing say, that various periods are required for the perfection of this process in the different bones. In this matter nature is always guided by the necessity of

the case: if the bone is required early to protect or to support, then it soon acquires a great proportion of osseous deposit, and assumes a determined form; thus we have the bones of the head and face, the clavicles, and the vertebral canal, very perfect in comparison with other bones of the fœtus; because the first have to contain the brain; the second to complete many of the organs of the senses, early requisite for the well-being of the infant; and the third has to support the weight of the arms, and prevent their encroachment upon the region of the breast. But, wherever no such necessity exists, we have nature taking more leisure in her developments, and numerous instances of this are seen in the infant; for, inasmuch as man does not stand erect until he is a rational creature, and capable by the exercises of his mind to support his exalted stature, the processes of the vertebræ, and of many other bones, which give power to the muscles to erect and move the frame, are, by reason of their being unnecessary, in a cartilaginous or medial state.

OF THE SOFT STRUCTURES ENTERING INTO THE FORMATION OF BONE.

The first to which we will direct our attention, are those which cover the *surfaces* of *bones*, viz.:—(1) the PERIOSTEUM and (2) MEMBRANA MEDULLARIS; we will then consider (3) those *entering into the substance of bone*, viz.:—*arteries*, *veins*, *nerves*, *absorbents*, *and cellular tissue;* and then conclude this section, with a few

remarks upon (4) the *addenda* to bones, viz:—CARTILAGES, ARTICULAR SURFACES, and LIGAMENTS, which last, form a separate part of Anatomical Science, known by the term SYNDESMOLOGY. (from ζυνδεσμοι ligaments, and λογος.)

1. PERIOSTEUM:—The Periosteum, so called from its furnishing the external covering of bones, is formed of fibro-cellular substance condensed into layers which, in some places, can be separated; these invest bones uniformly, being, however, combined inseparably in some places with the insertion of muscles, and at the various joints, reflected forward so as to line the *capsular* ligaments, and leave the extremities of the bones to be covered with a substance more suited to the office which they have to perform. In addition to being thus reflected from one bone to another through the medium of its lining the capsule of the joint, it is also continuous in a correspondent membrane upon cartilages, which, in contradistinction, is termed PERICHONDRIUM. This same membrane, also, where it lines the bones of the cranium, is arbitrarily termed PERICRANIUM, By thus lining the bones and cartilages, it fulfils several important offices, which are;—to transmit the vessels of the bone to which this membrane is a *vehicle*; to form a medium for the attatchment of muscles; to form also a *soft medium* between the bellies of muscles and the unyielding surface of bone; to help the formation of a bond of union between one bone and another in the adult, and one part of a bone and another in the fœtus; and lastly,

(at least, so say some, but fact hardly bears them out in their assertion,) to set bounds to the overgrowth of bone and to prevent its too great increase.

Now, inasmuch as the periosteum is condensed cellular tissue, it necessarily implies that its sensibility and vascularity must be diminished in proportion to its density. Older anatomists denied to it the possession of nerves, and also described its vascularity as not belonging to it, but to the bones. We need not, however, rob the periosteum to do the bones justice, but we may attribute to it also the possession of both *arteries* and *nerves*. It is unphilosophical to doubt altogether that of which we want the evidence of sight; forasmuch as every science clearly consists of two departments,—the theoretical and experimental; one of which speaks of doctrines, the other of fact; therefore incredulity is inadmissible, and is indeed repugnant to the purposes and pursuits of science, whether exercised in reference to the first or the last of these; because theory frequently discovers truth, before fact demonstrates it. So it is here: for, in a state of health, this membrane is very dense and semi-ligamentous, except at those interstices through which the vessels of the bone are transmitted, by which the doctrine of its possessing no nerves, and but a very limited intrinsic circulation, was rendered very probable; but then, says theory, it is a structure, like all others, vital in its origin and design, and, therefore, must possess the properties and organization of all animal

substances; and, lastly, comes experience, to furnish its information, that, although in health, the periosteum is nearly void of sense, yet in inflammation it is exquisitely painful, owing to the same causes whereby pain is produced in any other structure; viz.:—*increased sensibility, rendered morbid by the internal excitement of the arteries of the nerves, and external pressure upon them from the swelling without*, which stretches the membrane upon the unyielding bone.

Lastly, we close our remarks by saying, that the chief bond between the periosteum and the bone is the vessels and nerves, which enter and return from the substance of the bone, by which minute foraminulæ are formed, more numerous in the child than in the adult, because the vascularity of the former is greatest.

2. Membrana Medullaris: — This is a fine extenuated membrane, which lines the interior of all bones; and is especially demonstrable in the cylindrical or long bones; it is divided into innumerable processes, which not only *line the cancelli*, but are connected with each other in the form of *irregular bursæ*. It is highly vascular, and receives its vessels through canals, (usually described in the course of the particularizing of individual bones.) When the vessels of the *membrana medullaris* are injected, they are seen to make innumerable inosculations with the periosteum, and to ramify also in wide radiations over the surface of the membrane and cancelli.

Now, this *membrana medullaris* has an *office* to

perform, which is, *the secretion of the marrow.* The marrow is a thick oily substance, deposited in the *bursæ* before mentioned, and may be said to be of the same use as the adipose substance, or fat, in the cellular membrane of the body at large. May it not be here deposited to give passive resistance to the encroachment of osseous matter internally, which would cause the filling up of the cavity of the bone with earth, because its consistency is less dense, and therefore, less compressible than that of bone; at the same time, that it fills a reservoir thus made and preserved in the bone, for the deposition of nutrient matter, in the event of the natural supply through the alimentary canal being withheld? The marrow is remarkable for being vascular and thin in children; oily and dense in the adult; and copious and viscid in old age: hereby is demonstrated the great vascularity of the structures of the frame in children, and the diminished vitality of the solids of those advanced in life; for injections will penetrate into the medullary membrane with great facility in youth, whilst in the bodies of the old it cannot reach so far.

Like the other membrane, this possesses little sensibility in the natural state, beause it could answer no good purpose, being without the reach of stimulus from extraneous substances; yet inflammation also proves this structure to possess nerves. As for the marrow, it is but a secretion temporarily deposited and perpetually in a state of motion from absorption and secretion, being in

continued process of removal and replacement; it therefore necessarily contains no nerves, although the cellular membrane which forms its bags must of course be nervous; for, who ever heard of a secretion taking place without nervous influence? —the arteries secreting it must be supplied with nerves in their coats as surely as they are with vasa vasorum.

The marrow forms a beautiful object to be viewed through a microscope, resembling a cluster of grapes;—this appearance is occasioned by the arterial ramification, forming the stem, and the bursæ of the membrane, spherical in form, containing the medullary secretion.

3 OF THE CIRCULATING AND NERVOUS SYSTEMS IN THE BONES AND THEIR OFFICES.

We have anticipated our first remark upon this subject, that bones contain *arteries, veins, nerves,* and *absorbents.* Their *number* and *size,* however, are less in proportion than in those of the other structures of the body, and differ also in the same bone during the three different periods of life; infancy, maturity, and old age. In the first the *secerning arteries* are numerous, giving a redness to the bones, particularly to their expanded parts at the extremities, and filling up the sulci between the striæ of new-formed bone with their ramifications. The *veins* are necessarily as numerous as the arteries,—the *nerves* are in greater number in proportion than in the adult,—and the absorbents are active in the removal of cartilage. In the

second or medial state the arteries are less numerous, inasmuch as the bones have become enlarged and more dense, whereby, the cellular membrane has been extenuated into almost imperceptible bonds of union to the fibres of the bone, and the largeness of the caliber of the vessels has been infringed upon. For this reason, nature has set bounds to the growth of the bone, which, although continued, is diminished; and, therefore, the arteries are disposed the more to model the bone and perfect the processes for the origin or insertion of those muscles which are brought into exercise by the necessities and pursuits of manhood. The number and size of the *veins* keep pace with the arteries. The *absorbents* are also undoing what the arteries perform, taking up what they put down; but, as a bone is to become a permanent or durable structure, this absorbent action is kept within proper bounds. It is however the case, that even the bones are a mass of moveable particles,—the *interstitial deposition of the arteries* and *interstitial absorption of the absorbents* constantly keeping them in perpetual motion; no sooner is a particle of bone deposited in the membrane by an artery than it is taken up by an absorbent, and is forthwith carried into the circulation, when it is either sent to the kidnies for transportation from the body, or else returned to make a temporary abiding in another place in the skeleton; thus, on this principle, particles of the bones of the head may have changed place with some of the toes, so that anatomists have allowed

a complete revolution to transpire in the human skeleton, (according to some) taking the period of seven years for its perfect performance.

Now in old age, the extreme period of life, a very great change takes place; the vital structure of the bones is very attenuated, and the absorbents and arteries both exercise their propensities in an irregular and inverted manner. While the absorbents are sedulous to remove the osseous deposit from the cancelli and laminæ of the bone, and thus enlarge the cavities and make its specific gravity lighter, to help the old man's diminished energies, the arteries are condensing the external laminæ of the bone and rendering *their* gravity greater, to supply the lack of substance caused by the interstitial absorption. A very great deal of earthy matter is thus thrown out of employment, much of which is carried off through the kidnies, (which sometimes may collect in form of *calculi* in one or other of the urinary organs,) or else is deposited by the arteries in the soft structures, rendering *bony* that which had before, in a state of health, been elastic; as for instance in the trunks of the arterial system, which ossify through diseased action during the latter periods of man's existence. So that we see man is made to become his own executioner, not from choice, indeed, but from necessity; for inasmuch as the elasticity of his nature is superseded by the senseless and unstimulatable structures into which bone has found its uninvited and unwelcome entrance, the circulating and nervous systems are looked to by them

for increased vital energy, to render which they are indeed unable; and, instead of the glowings of health throughout the frame, is set up the excitement of hectic, which soon wearies out the susceptibility of the structure which nature had engaged it to support, and soon destroys the disposition of the nerves to be stimulated, and the blood to nourish, and the body seeks *that* change which *all organized matter* must undergo.*

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* OF THE BONES OF THE CRANIUM, SHEWING THEIR PECULIARITIES:—*The bones of the cranium* are lined on both sides with a membrane, and are foraminulated for the ingress of arteries into the diplöe: the internal table of the bones of the cranium, called from its density *tablea vitrea,* is deeply sulcated by the meningeal arteries of the dura mater, which supply the bones very extensively from within, while the frontal, the occipital, and the auricular arteries, supply them from without. Hence you see, there is a connection between the vessels of the internal and external parts of the skull, and these form one vascularity through the medium of the arteries of the bones. Now the reason that the cranium is so vascular is because it forms a cavity encasing a viscus of first importance in the animal economy:—it is the seat of *sense*—and according to the *perfection of the animal* and the *increase of its necessities,* and the *extent of education,* so will it rapidly enlarge; to explain,—inasmuch as the brain is the organ whose quality is *sensibility,* not only to *external impressions,* by means of the nerves, but also to *internal impressions,* communicated by the soul; so in accordance with the *extent of excitement* from objects from without or the mind from within, (which will cause *organic exercise* of the brain,) *so must be its increase in size and proportion*:—hence, if the mind of a child be suffered to enjoy an ignoble slumber, or the rational and animal propensities and affections are not brought into active exercise, then the brain will be comparatively small and un-

4 ADDENDA TO BONES:—CARTILAGES, LIGAMENTS, AND JOINTS.

Before proceeding to the consideration of the uses of bone, we will speak of the *addenda*, such as CARTILAGES, LIGAMENTS, and JOINTS; because they are so important in the skeleton that bones would be of no use without them.

CARTILAGES:—With regard to the *structure* of cartilages, we have before said a little on this subject, to this we will briefly add, that they are a *white dense substance*, proved to be *fibrous;* that they contain a small proportion of *earth;* that they form *no variations of structure within*, as bones do in their *cancelli;* no *interior membrane;* that their external membrane is continuous with the periosteum, and is called *perichondrium;* that they are *variously vascular*,—in those which are to become bone they may be easily injected,—in those which are permanent, as for instance, the cartilages of the ribs, (where there is a *central artery*) the vascularity of their substance is less, while it requires inflamma-

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developed (and, certainly, less vascular, because it is a passive organ); but if we see on the other hand, an active mind, or violent passions, shewing vigorous exercise of the animal propensities, then the *brain will increase* in proportion to the energy of the mind, or the necessity for the exertion of any natural power; just as another material organ would increase by its constant excercise; for instance, the biceps muscle, when much used by handicraftsmen or pugilists. Therefore, that the skull may be modelled to the brain, and enlarged with the development of that organ, *it is necessary* the bones should be possessed of *a vigorous circulation*.

tory action of a high degree, and continued to a great length of time, to demonstrate the vessels of the cartilages of the joint, into which, in a state of health, red blood does not enter.

Cartilages are either *temporary*, as in those of the bones of the fœtus, which are soon superseded by osseous deposit; or *permanent*, as in those of the joints, ribs, larynx, etc.

With regard to the *nature* and *properties* of cartilages, they are *elastic*; if we pierce them with a knife, they repel the offending instrument, and on its being withdrawn, close up the aperture it has made.

With regard to the *uses* of cartilages, they are various. In the first place, as has been already described, they form a *substitute for bone in the fœtus*, as well as in the *adult;* examples of which we have in the larynx, trachea, bronchial tubes, etc.: they form parts of cavities requiring latitude of motion, and permit themselves to be acted upon by muscles for the contraction of these cavities, and then re-act by reason of their elasticity, when muscular action ceases, to expand the cavities they bound; as instanced in the alæ of the nose, the cartilages of the ribs, cartilages of the larynx, &c.: they coat the bones of the joints, where, on the same principle just mentioned, they re-act upon the impression made on the extremities of the bones, and thereby prevent concussion. They also give latitude to motion by being situated between the articular surfaces of a joint; as for instance, in the joint of the jaw-bone, where there

is an interarticular cartilage and a double capsule, so that the extent of articular surface is increased, and, consequently, the latitude of motion. Another species of cartilage, termed *intervertebral substance*, admitting great and peculiar motion between the bodies of the vertebræ, will be particularly described in that section.

LIGAMENTS:—These are the natural bonds of union between the bones in the *natural skeleton.* They are glistening, strong, flexible cords of condensed cellular membrane, not *extensible* or *elastic*, unless their texture has been modified into a less degree of density, on the one hand, or into a semi-cartilaginous condition, on the other.

With regard to the *structure* of ligaments, it is *fibrous*, the cords running for the most part longitudinally, or on a parallelism with each other; this mode of arrangement is particularly adapted for the purposes required. Ligaments may be divided into two principal kinds:—*ligaments*, properly so called, and *capsular*. These latter are membranes of a less degree of density of structure, and of greater vascularity, possessing vessels which secrete on their internal surface a peculiarly glairy fluid termed *synovia*, the intention of which is to lubricate the surface of the joint, and to prevent friction. Entering into the formation of ligaments may be traced *arteries*, *nerves*, and *veins*, and, although neither the vascularity or sensibility of these organs are equal in the natural and healthy condition of the joint to the membranous structures surrounding, yet, in the inflamed and diseased, they are both considerably and painfully greater.

But beside forming the natural link between the various bones, which is one of the principal uses of the ligaments; they also supply the place of bone (as instanced in various parts of the pelvis); give origin to muscles (as in the wrist and pelvis, and particularly in those parts where intermuscular ligaments exist); complete the sockets for bones to move in (as in the socket of the astragalus); form loops for the intermediate tendons of various muscles to play upon bone in (as in the instances of the trochleares and digastricæ muscles); and lastly, bind tendons to the bones (as in the annular ligaments of the wrist and ankle).

PARTS AND USES OF A JOINT:—Every joint, however simple, is formed of at least one or more parts of separate bones brought into apposition. As the word joint is of such general meaning, it is applicable, equally, to an *immoveable connection* between two or more bones, as to one of *extensive motion;* but as science has classified these two, and their intermediate varieties of articulation, we will subjoin each of them, with the terms illustrative of them, and an account of the peculiar characteristics of each form of connection.

The *connections of the bones* of the body may be classed in *two primitive divisions*:—1. *Those without motion;* and, 2. *Those with motion.*

1. *Those without motion*:—these must be either SYNOSTOSIS, *which is, union of substance;* SYNARTHROSIS, or, *immediate apposition of bone without intervening soft structures;* or mere SYMPHISIS *connections, which are unions by unyielding inter-*

mediate substance. ***Symphisis***, however, implies all kinds of connections with intermediate substances, whether admitting great, or no motion at all.

Three kinds of SYNARTHROSIS *connections* :—I. SUTURE is the riveting together of the bones of the cranium, and some of the face, by the dentations of one bone being received between the indentations of the other. The sutures are :—the *coronal*, *saggittal*, *lambdoidal*, *squamous*, *additamentum suturæ squamosæ*, *additamentum suturæ lambdoidalis*, *sutura transversalis faciei*, *zygomatica*, *jugomaxillaris*, *palatina longitudinalis*, *palatina transversalis*, *nasalis anterior et lateralis*, *lachrymalis*, and *incisoria;* all of which are adverted to in the demonstration of the bones of the cranium and face.

2. GOMPHOSIS is that kind of connection by which a process is fixed into a depression in another bone, just as a nail is into a board. The teeth, which are implanted in the alveolar sockets, are an example ; the *nasal process of the frontal bone ; the azygous process of the sphenoid bone*, *received into the vomer*, *etc.*

3. SCHINDELYSIS is similar to the last, only that the mode of connection is drawn out, making a *furrow* instead of a *socket* for the implantment of the bone. Thus the *nasal process of the ethmoid bone* is received into the upper edge of the *vomer*, and the *under edge of that bone* into the *sulcus upon the floor of the nose*, etc. Of the *symphisis connections* admitting no motion, two

good examples are seen in the *symphisis pubis* and *sacro-iliac*, of the pelvis.

2. *Those with motion:—Three kinds of* SYMPHISIS *admitting motion:—*

1. ARTHRODEA connection, is the coaptation of the opposed surfaces of two or more bones to each other, having capsules of strong ligamentous substance, admitting the slightest degree of motion, called *yielding;* the bones of the *carpus* and *tarsus* are good examples.

2. GINGLEMUS.—Here the bones are so apposed as to admit of hinge-like motion. This is subdivided into,—1. ANGULAR, where the motion is similar to the movement of a door on its hinges, as the *inferior maxilla* upon *the head, the elbow, knee, ancle joints*, etc. 2. CIRCULAR, where *lateral* and *twisting* motion is allowed, as between the bones of the fore arm, the *atlas*, and *vertebra dentata*, etc.;— and 3. COMPOUND, where *two or more ginglemus joints exist*, as, between the *occiput and atlas*, and the whole *vertebral column.*

3. ENARTHROSIS, is a *ball and socket joint*, permiting *extensive motion in every direction*; the best examples are the *shoulder and hip joints.*

The general characteristics of a simple joint are these; the articular surfaces of the bone covered with elastic coats of cartilage, the circumferences of which are thin and insensibly lost; the bone also foraminulated at this part for the ingress of arteries necessary for the vitality of its structures; a capsular ligament, more or less membranous or ligamentous, as the necessity for strength is greater or less;

and over this capsule two bands of ligamentous fibres, situated at two of its sides, and are mostly called *lateral ligaments*, which are to give strength to the joint and confine its motion; in these joints the internal surface of the capsule secretes the *synovia.**

Now to this mode of structure, all *compound* or more *perfect joints* have added either a *synovial organ*, or an *interarticular cartilage*. The former is a mass of fat attached to, or confined in, a part of the joint covered over with, and excluded from its cavity by the capsular ligaments. As far as its *colour* is concerned, it is in some joints of the colour of fat, in others it is more red or vascular, in consequence of the vessels dispersed in its substance.

They have been designated *glands*, but their structure is in nowise glandular; nevertheless, from the extremities or circumference of this substance processes of membrane of a fringed form (*fimbriæ*) extend into the joint, carrying their *synovial secretion* into its cavity. But so minute are the ter-

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* In fact, the simplest idea you can have of a joint, is a *shut sac* or *bag*— this is the capsular ligament; and two hard substances opposed to each side of it and pressed together, for instance, your finger and thumb—these represent the bones; then a piece of string wound around all three keeping them together—this forms the *ligaments;* while the air or water in the shut-bag represents the *synovia;* let that be in such great quantity that the finger and thumb cannot compress the bladder or sac, and then you have hydrarthus or dropsy of the joint: forgive the homeliness of these comparisons.

minations of the ducts, if indeed they exist, that they have not yet been discovered. The synovial secretion is so liberal during the use of the joint, when mechanical pressure is made upon the gland by the bone, that a very considerable absorbent system must be in connection with each articulation to prevent hydrarthus or dropsy of the joint; hence it is reasonable to suppose that absorbents arise not only from the whole surface of the capsule, and also from the synovial mass, called *gland of the joint*, but that some other modification of structure should be found in the compound joint, for the purpose of giving a larger surface for the mouths of the absorbents to arise upon. So that, I believe we have (for instance, in the knee) a *mucous fold in the joint, just as there is an omentum in the abdomen*, to fulfil this necessary and principal duty; and as the omentum is for the purpose of *absorbing* as well as *secreting* the serum of the peritoneum, so the mucous fold in the joint is for the absorbing as well as the secreting of the synovial fluid, and I should think, the *more for the former than the latter purpose.*

Interarticular cartilage possesses all the characteristics of cartilage in general, and elasticity in an eminent degree. It is *divided* into *the stationary* and *the loose.* As a good example of the former, we have the *semilunar cartilages of the knee joint;* as an instance of the latter, the *loose cartilage of the under jaw;* in this latter instance too, we must have a *double joint* and *two capsular ligaments*, whereas in the *stationary* or *incomplete interarti-*

cular cartilages we have them not occupying the whole cavity of the joint, but giving inwards their sharp margins, over which the capsule is reflected, and they are thus, as it were, in point of fact, turned out of the joint, in the same way that the extremities of the bones are also, for they and their cartilaginous encasements are covered by modified capsular membrane.

Nerves are known to enter into all the structures or joints, more by their sensitiveness in a state of disease, than by the discoveries of anatomists, although a Monro, Swan, or White, may have handled the scalpel, and investigated with the microscope. In the comparative absence of these organs, and of sensation in health, and the painfulness of a joint in a state of disease, the lesson is taught us, not to judge *a priori* of any thing touching the minute organization of structure; this was too much the fault of the ancient anatomists, who supplied from their *faith* what was wanting in their *observation;* now moderns run into opposite extremes, and are in danger of *doubting*, unless they have ocular demonstration.

III. USES OF BONE.

Though we now say that the uses of bones in general are to give shape to the body, a firm frame for the origin of muscles, and to form cavities for the protection of viscera, yet, in the description, will be appended the peculiar uses of individual bones.

THE SKELETON.

This word means the *frame* or *foundation* of any piece of mechanism or organization; with anatomists, it is understood to signify the bones or hard structures of man and animals, united and connected into their natural form, to which the soft structures are attached; thus the shell of the crab, the scabrous case of the beetle, and the sclerotic coat of the eye, are their several skeletons, which they possess on their exterior, whilst man, and the higher orders of the creation, hide them within their bodies, cloak them with soft structures, and present a skin on their exterior, either naked or covered with hair.

We have to do with man, who is an upright animal, therefore his bones are modified to afford him an erect posture. Those bones which have to be moved in progression form the base of the skeleton, and receive the weight of the body; hence the feet are an *expanded arch*, and the thighs and legs *moveable columns*, whilst the toes are *prehensible appendages*, possessed of a power of adapting themselves to uneven places, and of retaining more securely the position of the body, but which, by the restraints of civilization, are abridged of many of their capabilities, which they exert to perfection in a savage state. Upon these moveable columns are fixed an osseous basin called the *pelvis*, which forms the inferior support to the weight of viscera contained in the abdomen, and also gives origin to the muscles which comprise its anterior boundaries, and to the moving muscles of the thighs. As will be

shewn in the description of the bones, this pelvis forms an arch, which receives the central line of gravity from the trunk, and throws it upon the extremities.

The *vertebral column* is the *central pillar* of the trunk; *moveable*, to permit the trunk and neck to rotate and bend; *incurvated*, to allow room for the visceral organs, for the origin of muscles to keep the trunk erect, and to prevent concussion in the more violent exercises of the body; and *hollowed* into a canal for the protection of the spinal portion of the nervous system. The *ribs and breast bones* make a *moveable cone*, which is completed by the vertebræ behind on which it is fixed. Thus a frame of protection is made for the heart, and moveable levers in aid of respiratory action.

The *superior extremities* are endued with great motive capabilities; are fixed upon the upper part of this cone very loosely; and possess appendages called, *fingers*, which have extensive prehensile power.

The *cranium* is placed upon the top of the vertebral column. It is the capitolium to the body. It contains within its helmet of bone the brain, the organ of sensibility, upon which the influences of the soul are made to dwell; and it carries in its cavities and upon its surfaces the external organs of the senses, through which the brain is stimulated from without, and which require for their perfection eminent or exalted situations. Here are the orbits in which the eyes, those watchful sentries of the mind, are found ever on their guard: here, too,

deeply hidden in their own labyrinths of bone, are to be found its auditory monitors: here its olfactories, those suspicious inspectors of nuisances: here, too, are the vaults of the voice, from which stentorian sounds and soft melodious whispers often issue; and here is the great *portal* to the system —the main entrance to the whole fabric—guarded by thirty-two strong orderlies armed cap-a-piè with enameled coats of mail, and by whose permission all the provisions of the garrison find their way to the store-chamber. In looking then at the skeleton in its natural position, as built by the word of the Creator, we are astonished to see the wisdom displayed in this one fact,—that although scarcely any of the bones are placed so as to form a column of a strictly perpendicular direction, yet that the central line of gravity strikes through their common base, so that the body is as erect, and as firm, as if this central axis had been an immoveably osseous, and not a supposed, line. The arched deviations of the vertebral column are not absent; every limb—every line—has its beautiful wave, whereby all that is *formal* is avoided, but all that is *regular* is preserved.

IV. DISEASES AND AFFECTIONS OF BONES.

The *diseases* of bones are:

INFLAMMATION, which terminates in EXOSTOSIS *simplex*, which is analogous to *resolution;* ABSCESS, or *suppuration;* CARIES, or *ulceration;* and NECROSIS, or *mortification.*

The *altered organizations* of bone are:

MOLLITIES OSSIUM, or *preternatural softening of bone;* FRAGILITAS OSSIUM, or *preponderance of earthy matter;* and EXOSTOSIS, or *redundancy of bone.*

The *accidents* of bone are:

DISLOCATION, or *separation of one bone from another;* and FRACTURE, the *disunion of one part of a bone from another.*

INFLAMMATION OF BONE.

This serious and universal affection exists of course in all soft structures, and, consequently, in the membranous parts of bone, which are not however easily brought into an inflammatory state, but which, when this is induced, cannot withstand it long, and hence speedily either undergo its ulcerative or mortifying terminations. The symptoms of this affection are different to those which accompany its existence in a soft structure properly so called. Its presence in a bone is indicated by a deeply-seated obtuse aching pain, described as more distressing than acute, and so harassing the health as speedily to bring the patient to a state of great emaciation and weakness. If inflammation first commenced in the soft structure in its substance, it now stretches to the periosteum, which swelling upon the hard incompressible bone to which it is in close cohesion, causes pain of an intense degree, because the nerves have become morbidly sensible; a tumour is now formed, which is the result of the sympathetic inflammation extending to the parts in

the vicinity, and ultimately includes the skin, which it reddens and excites.

This inflammation may be either gradual or active, and may be caused by accident, or constitutional disease, such as scrofula or syphilis; of course, therefore, the same line of treatment must not be pursued in every case. Now it is evident that if the inflammation be the result of scrofula or syphilis, it is but the appearance of those disorders in this particular form. Scrofulous patients have generally weak, lymphatic, flabby organizations, with a contaminated circulation; blood containing a large proportion of serous and aqueous parts, and what there is of the coagulable is not firm of texture, or so elastic and contractile as that of a person in health. Indeed, in these subjects affected with scrofulous taints, inflammations of structure are an effort of nature, who attempts thereby to stimulate and induce a re-action in the frame; but there is not sufficient vigour in the part to withstand undue or increased action, and thus failing in one resource, nature immediately adopts another, and forms, as it were, for the patient a spontaneous issue. This disposition may be laid hold of by surgery, and assisted, if it affected only a soft structure near to the surface; but herein is the error—the setting up of this action in a *bone*, where almost necessarily either *caries* or *mortification* must take place. But this may be said in favour of the foregoing case, that the inflammation induced by scrofula is generally of a chronic character, and therefore some time at least is allowed for the adoption of a curative process.

It is evident, therefore, from the constitutional weakness of a scrofulous patient, that bleedings and other evacutions are decidedly injurious practice, and that the indications are rather to prop up and nourish the system than to depress what little energy there is. In fact, this inflammation, as has been said before, is an effect of topical weakness, and an attempt of the constitution to cause general re-action; but instead of producing the healthful stimulus of a vigorous circulation, it only induces the irregular flushes of a febrile excitement, and therefore our practice must be to give tone to the system by medicine constitutionally, and to counter-irritate the surface near to the affected bone. For this purpose, blisters, reiterated and kept constantly open with savine ointment, or blister cerate, or ammoniacal plasters, and stimulative embrocations, are to be employed. If the cause be *lues venerea*, then the same line of conduct must be proceeded in as before described, with this variation, resulting from the situation of the inflammation being generally in the periosteum (termed NODE), that as the bones are chiefly superficial in which nodes are formed, if the pain and swelling are very great, and attended with nocturnal exacerbations, a free incision may be made into the periosteum, and opium administered, and this will cause decided relief. A course of mercury seems, by general consent among surgeons, to be the most feasible mode of treatment in venereal cases, and it is presumed, therefore, that the patient will be here submitted to a mercurial action, in the course of

which, the inflammation or node will gradually disappear.

Now, if the inflammation be the result of injuries inflicted; then, upon the strength of a good constitution, you may evacuate both the veins and the bowels, and use any antiphlogistic measure the urgency of the case warrants. But still, after all, too often this is but the beginning of a train of diseases which afterwards speedily appear, complicating together abscess, caries, and exostosis, in a manner similar to the combination of suppuration and imperfect resolution in a soft structure after common inflammation.

Let us, however, next consider the effects and treatment of abscess in bones.

ABSCESS.

This termination of inflammation, properly speaking, is confined more or less to the *surfaces* of bones; that is to say, either to the medullary membrane, or to the external part; and it is also, at the same time, less evident and perfect in this than in the softer structures, and always to a degree complicated with partial losses of structure, by ulceration and mortification, as well as by absorption, if allowed to continue to any length of time. Thus there will be found this difference owing to the variety of structure, that while, in suppuration of a soft part, the loss of substance is the result of absorption, in abscess of bone there is to a certain degree, if the affection be extensive, a loss of vitality in some one part or other of the

bone, because the absorption is not so active in a hard as in a soft structure, neither indeed can be, because of the various distribution of living parts, and their altered suppurative action. But I must not be understood to lay this down as a rule without exception, because, in every man's practice, cases have occurred where there was a denuded bone, from the surface of which, good or "*laudable*" pus was secreted, but where healthy granulations formed, and the bone was covered without loss of substance or alteration of structure.

In all cases of abscess of bone, there is great constitutional irritation, and much distressing pain; the inflammation of the soft structures and of the skin extends, the latter becoming puffy and emphysematous; rigors of fever and emaciation of body now appear; then the tumour in the soft parts over the bone gives a fluctuation of a fluid which proves the ulceration and death of a portion of the bone, and a communication between the interior of the abscess and the parts beneath the skin; and which, if left to itself, progresses towards the surface as another abscess would, when ulceration and absorption soon make an outlet, from which pus sanious and fœtid is expelled, containing spiculæ of mortified bone, and clots of coagulable lymph; then either the repeated discharges of pus and the constitutional hectic destroy the patient after a time; or else healthy granulations gradually fill up the cavity, and a tardy cure is effected.

Now the efforts of the surgeon should be di-

rected to two objects:—in the first place, to form an accurate prognosis, and then, well satisfied with the existence of an abscess, to hasten its progress by artificially helping the expulsion of the fluid by means of the trephene, and using stimulating applications and injections to correct the acridity of the pus, and induce healthy granulations.

CARIES,* OR ULCERATION.

This third termination of inflammatory action in the bones, is analogous to the ulceration of the soft structures, in which nature causes a cavity or breach by absorption. The *causes* of caries may be either external or internal; *i. e.*, either contusions or injuries, from without; or from within, abscesses; a morbid action; the effect of scrofula; venereal taint; the pressure of tumours, cancerous or aneurismal, etc.

Caries may be either the result of a *constitutional affection*, or on the other hand, altogether *local;* in the former case it is induced by scrofula, lues venerea, scurvy, or other universal diseases: in the latter case, accident, or the contiguity of a diseased structure, imparting to the bone its morbid action, may be the immediate cause of its existence.

Thus, scrofula is found to affect the lymphatic and secerning systems, therefore the spongy structure of the bones, and especially the bones of the tarsus and carpus, are very generally affected,

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* Derivative, χειρω, to abrade.

because they are spongy in texture, and situated near to and surrounded by joints, in which, no doubt, an hydrarthropsy is consentaneously induced.

Although the venereal disease is more generally liable to produce necrosis, yet it is ofttimes a cause of caries. Numerous examples of caries resulting from venerea daily crowd the hospitals, both in France and England, where that horrid disease is perpetuated by the unbridled licentiousness of the lower orders of society; so that the face is seen to be marred, and the voice, which is the distinguishing prerogative of man, is diminished from the commanding and sonorous tones of the temperate and healthy, to the painfully enervated and insignificant whispers of the suffering victims of vice: the palate, the nose, and the forehead, are ranked among the most frequent parts to suffer by this disease, so that the common roof of the mouth and floor of the nose is removed, and a revolting communication is established between them; the food regurgitates through the nostrils, the mucus of the nose is ejected from the mouth, and the voice is a confused gutteral sound, combined with that which resembles the escape of air from a wind instrument which is cracked. The tibia also, and the sternum are frequently affected by caries, arising from venereal disease.

Caries of the vertebræ produces that peculiar disease which is adverted to under the head of diseases of the spine; paralysis and lumbar abscess are frequently its results. Caries of the soft and spongy bones is more obstinate to cure

than that disease in the hard or dense ones; as for instance, in the tarsus the proximity of the bones, and the consentaneous disease of the joints, being particularly favourable to a spread of the disease from the one to the other.

Diagnosis:—In order to distinguish caries from necrosis or death of the bone, with which some have confounded it, it will only be necessary to state that, in necrosis the vital principle is completely gone, whereas in caries, a morbid but vital action is operating, although the balance of the circulating powers is lost, and the diseased part is undergoing alteration of texture. Caries in a subcutaneous bone is easily detected; if you introduce your probe through the ulcer in the skin you can pass it into the substance of the bone, which is preternaturally softened; but in deeply-seated bones you ascertain a caries, when a fœtid discharge is seen to exude from a fistulous communication of the soft parts; these, however, in both instances, being points of consideration to be judged in connection with the evidence afforded of constitutional affection by some one or other of the diseases aforementioned, in the one instance, or of the reception of a blow or other injuries from without, in the other.

Treatment: — This must of course be of *two kinds—constitutional* and *local*. In venereal cases, mercurials and sudorifics are indicated;—in cases of scurvy, acidulated drinks, and vegetable diet; in scrofulous affections, alteratives, corroboratives, and antimonials, form the general classes of medi-

cines to be used. But in *local cases*, the exfoliation is promoted by discutient powders and stimulants; that which will correct the fœtor of the discharge, will also hasten the separation of the diseased part, such as lint, dipped in tr. benzoes comp. aloes, or myrrh, liq. argenti nitrat., etc. The actual cautery is sometimes used in France, after the bone has been fully exposed by the scalpel, but if the disease exist in the tarsal or carpal bones, and the morbid action is extending from one to the other, and the constitution suffer, then amputation is the surest, nay, the only and last remedy which the surgeon can put in practice. Much further investigation is necessary, and will prove very interesting in reference to the development of caries in the different bones and cavities. Many surgeons have contributed their information on this subject, but fewer on this than on most other surgical diseases.—Let the student, however, consult Cooper's First Lines, and Hey's Practical Observations in Surgery, etc. Some remarks on this subject, in connection with gunshot wounds, may be found, I believe, in Guthrie, one of the best surgeons the nineteenth century has produced.

NECROSIS,* OR MORTIFICATION.

This term is applicable to the death of any part, but it is distinctly and exclusively confined by surgeons to the destruction of bones. This disease (in like manner, that caries is ulceration) is *mor-*

* Derived from *νεκροω*, to destroy.

tification of bone, or the *fourth termination of inflammation in the hard structures.*

Symptoms:—A deeply-seated pain, indicating by its intensity an exceeding degree of inflammation, accompanied with swelling and sympathy of the parts in the vicinity of the bone; this inflammatory action lives long enough to form a collection of matter in the cavity of the bone, and to ulcerate or render carious a point in its parieties, which becomes fistulous, and discharges purulent matter, more or less of good kind, mixed with coagulable lymph and spiculæ of dead bone; then having arrived at its climax, the inflammation where it is most acute destroys itself, whilst the lesser degrees are modified into ulcerative, suppurative, and regenerative actions. To explain by an example of necrosis of the tibia, one of the most frequent bones which it attacks: after the swelling of the leg, accompanied with a deeply-seated pain, causing great anguish, and proving the existence of the high inflammatory action in the centre of the bone or its cancellated part, there is found an ulceration on the anterior subcutaneous surface of the tibia, from which, upon correspondent ulceration of the soft parts producing a fistula, issues a collection of matter, the result of the suppurative process within the bone; subsequently, after a short interval, a loose hard substance is felt within the cavity at the bottom of the fistula, or in the hollow medullary interior; this is the dead bone, technically called the *sequestrum*, which is the result of the mortifying process, or the final termination of inflammation.

Thus we have five actions induced in a disease of this kind: — firstly, inflammation; producing, secondly, suppuration or abscess; then, ulceration or caries; and fourthly, mortification: the fifth action is the regenerative one—an effect of healthy inflammation, and is analogous to the primitive growth of bone, or to resolution and the granulating process in the soft structures; so that the most favourable case is where the ulceration gradually heals, the sequestrum never presents itself, but is absorbed into the system, and the disease is cured without any thing remaining but a permanent enlargement of the bone, and callosity of the soft parts around it. Another case results in the extraction of the sequestrum after a longer or shorter period, and with various degrees of inflammation, suppuration, and pain; the hollow becomes filled up with granulations, which, in process of time, becomes bone, and converts that which was primarily a cavity into a solid mass.

Here I have been describing a necrosis, affecting only the interior of the bone, but in many cases the whole bone has become the sequestrum except the extremities forming the joint, the shaft separating at the epiphyses, new bone being formed around the old, and absorption, or else extraction, ultimately causing the removal of the old, previous to the complete regeneration of the new bone, so that the limb has been restored to all its functions and capacities.

Necrosis is most frequent in the tibia, femur, clavicle, maxilla inferior, humerus, radius, and ulna.

The disease is most prevalent between the ages of twelve and twenty, with the exception of the lower jaw, which is diseased in later years. It is not unfrequently the case, that two bones are at the same time diseased, owing to sympathy and constitutional affections. The process of cure is more rapid in the lower jaw, but is very protracted in the cylindrical bones; for whereas nature may cure the former in the space of a few months, because the bone is small, the circulation is vigorous and near the centre of arterial action, and the patient must eat; she does not cure the latter for a year, or even two, because the bones are generally greater in extent, are farther from the centre of the vascular system, and not necessary to the life of the patient.

Treatment: — The indications are several and important; namely, 1. To sedulously meet with antiphlogistic measures the attacks of inflammation which occasionally occur. 2. To build up the constitution and fortify it against the general fever which ofttimes attends. 3. To treat with general measures the constitutional cause of the necrosis, whether it be scrofulous or syphilitic. 4. To promote the separation of the dead bone and the regeneration of the new, by assisting nature, and following her in her attempts, whether it be on the one hand to *inclose the sequestrum with living bone*, or on the other, to *expel it* from the fistula created by ulceration; which latter is to be done by an operation hereafter to be described. 5. If, failing in these, the constitution becomes too much affected,

then to have recourse to amputation, when practicable, to prevent the patient's death.

The first inflammation is necessarily the most extensive and most dangerous, and frequently renders amputation the only remedy the case will admit of; if, however, the patient gets the better of this, by the assistance of general and topical bleeding, poultices, and fomentations; then the surgeon turns his attention to the separation of the *sequestrum*. In the case where nature is doing this process properly, and the line of separation is accurately made, and absorption gradually induced; then the least interference on the part of the surgeon is better for the patient. *Counter-irritation* now becomes the proper line of treatment; blisters occasionally applied, and kept unhealed by savine ointment, promote the absorption of the *sequestra*, and prevent the accessions of extensive suppurative actions.

But when the dead bone is source of great irritation, and the absorbents have lost or relaxed their efforts to remove it, where the *sequestrum* is tangible, though immovable, and the bone itself is superficial; then art can and ought to assist nature in its removal. For this purpose, after laying bare the bone with a scalpel, Hey's saws or the modiolus of a trephine may be used to make an opening through the new bone large enough for the sequestrum to be extracted; which is to be separated by means of the forceps, gouge, Hey's saws, or any other instruments which the surgeon may think applicable. This is a painful

and revolting operation, but surgeons must not demur to practise it; although there be no science or delicacy, and sometimes not a little physical strength necessary in its performance.

2. The *altered organizations* are:—

MOLLITIES OSSIUM.

Mollities ossium may be defined an unnatural softness, permitting flexibility of the bone, resulting from one of the following two morbid actions, induced in it from unknown causes:—inordinate action of the absorbents upon the phosphate of lime; or imbecility of the arteries, which do not secrete the earthy matter in sufficient proportion.

Happily this disease is rare, for in all cases upon record, no treatment hitherto has been found to succeed. The disease begins, perhaps, with pains in the limbs, attended with a general morbid excitement, causing nocturnal profuse perspirations; the secretions become more large, especially the urinary, which is of a dark orange colour, and peculiar odour, and deposits a white earthy sediment, which is, in fact, the phosphate of lime; the limbs now become sensibly weak, inducing an instinctive caution in the mind of the patient, which influences very particularly the will, so that there is little or no propensity to exertion, and which is ultimately precluded by their becoming œdematous and flexible. The disease now affects the bones of the trunk, and the chest and back are considerably deformed in consequence: the injuries and interruptions, caused to the respiratory and other vital

organs, as well as the morbid action which is communicated to these viscera, speedily bring on convulsions, fever, difficulty of breathing, and universal derangement, which terminate in death.

It must be extremely difficult to form a correct opinion, as to whether the disease be the result of diminished arterial secretion, or increased absorbent action; and a much greater difficulty to accommodate treatment to the state of the disease: perhaps vigorous counter-irritation in the beginning may be of service; setons, blisters, issues, extensive cuticular excitement, and ulcerations. But it is manifest, that if the surgeon mistakes the cause, that is to say, the *immediate* or *organic cause*, then the treatment may assist the disease, rather than contribute to prolong the patient's life.

In reference to *rickets* two things are observable, which tend to render a distinction accurate; the distortion is slow, and the flexibility is but temporary, and beside the young only are affected by it, whereas mollities ossium is a disease of the adult period of life.

FRAGILITAS OSSIUM.

A preternatural brittleness of bone. This results from either of these two circumstances,—a predominance of osseous secretion over the gelatinous; or, the absorption of the soft structures, especially of the gelatine. These two circumstances, therefore, must be the result of inordinate deposition of earth, by the arteries of a bone; or, inordinate interstitial absorption of the soft parts, by the absorbent

system; so that if mollities ossium be a deficiency of lime, fragilitas ossium is a redundancy of earth in the bone. (Boyer) To a certain extent fragilitas ossium occurs in old age; because, as before remarked, the bone becomes denser, and the earthy constituents predominate over the animal; whereby the bones of old persons are rendered more fragile, and when broken, re-union is more uncertain, and longer protracted than in youth.

The immediate cause of fragility, is a morbid action affecting the secerning or absorbing vessels. As exciting causes may be mentioned, syphilis, in the latter part of which disease, the bones affected by it have been clearly proved to have become fragile; scorbutic affections; cancer in the vicinity of a bone, or causing constitutional excitement; and lastly, old age. It is clear therefore, that it is useless to attempt the cure, without the removal of the exciting cause, which is seldom to be accomplished, and in the last mentioned, of course entirely impracticable.

EXOSTOSIS.*

This is an inordinate growth of osseous substance, attaching itself to one or more parts of a bone. Now exostosis is of two sorts; one, *spurious*, where the tumour is only attached to bone or is *fungous;* and *true*, where it grows from the very substance of bone itself.

True exostosis, then, is a preternatural growth of

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* Derivative εξ, out, and οστεον, a bone.

bone, which acquires the hardness and appearance of ivory, inasmuch as the fibrous character of the bone is lost:—and *spurious exostosis* is an increased growth of bone, spongy in structure; or, it may be a thickened state and growth of the periosteum with osseous deposits; or, thirdly, it may be a cysted tumour, partially osseous and membranous, whether attached to the periosteum, or connected with the substance of the bone itself. The bones of the scull, the maxilla inferior, the sternum, humerus, femur, and the bones of the fore arm and legs, are most subject to this disease.

As to the causes of exostosis, there is much obscurity; nevertheless, there are certain facts which observation has afforded, which go to prove that in the majority of cases it results from constitutional predisposition: thus, if a tumour of this nature affects one bone, it is often found to affect another or more at the same time; thus, node, which is unquestionably a species of this disease, may exist in two or three parts of the skeleton, as the result of constitutional causes. Howbeit constitutional predisposition could never operate, if it did not find consent of action or passion in a local organ. And therefore we may safely aver on the truth of this, that in every exostosis there is a local if there be a constitutional cause, whether undue excitement of the vascular system in the bone, or violence from without.

Exostoses are often removed if they be superficial, cause pain and excitement, injure the health, or interfere with the comfort of the patient;

and exostoses are often removed to gratify the meddling propensities of the surgeon. Now the remedy is really worse than the disease, unless urgent necessity compels its adoption, and should never be performed where mere deformity is the result of the local affection. The object then in the removal of all exostoses, is to get at the base of the tumour, and then extirpate the whole by the best means you are able,—whether by gouge and mallet, like a stone-mason, or by Hey's saw and scalpel, like a professional man.

I once saw an operation performed in St. George's Hospital, Hyde Park Corner, where a poor woman had the whole side of the lower jaw removed, in consequence of an encysted osseous tumour situated on the bone, but which upon dissection was found to be independent of it altogether, —the jaw was perfectly healthy. Why did they not, when the skin of the lower part of the face was reflected over the neck, and the tumour thus fully exposed—why did they not attempt its removal, and certify themselves of its true character, before they deprived this poor woman of half of her jaw, and, as it proved in the issue, of her life also?

3. The *accidents* of bone are:—

DISLOCATION.

The disunion of one bone from another, whether by accident or disease.

Dislocations are of *three kinds:* 1. *Imperfect*,—where the articulating surfaces are partially in contact; 2. *Perfect*—where there is no apposition of

articulating surfaces; and 3. *Compound* — where there is a wound of soft parts communicating with the cavity of the dislocated joint.

Dislocations further differ: 1. From the nature of the joint and extent of surface; 2. From the direction which the protruded bone takes; 3. From being *primitive* or *consecutive;* 4. From the length of time after the accident; and 5. Whether they be the result of accident or disease.

Imperfect dislocations frequently exist in arthrodial and ginglemoid joints; in the latter they may be said to be invariable, inasmuch as it would require extreme violence to cause a *perfect dislocation.*

But in enarthrosis connections, *perfect dislocations* always exist, and there you may have the dislocated bone taking many directions, either *upward* or *downward*, *forward* or *backward;* or subsequently from being *primitive*, you may have them become *consecutive*, by changing their original place, and bearing a different relation to the cavity of the joints from which they were protruded. Thus, for example, the ball of the shoulder joint may be a primitive dislocation into the axilla or armpit; but by a fresh accident or unskilful treatment it may become a consecutive dislocation forward under the pectoral muscle.

Compound dislocations, like compound fractures, require much accuracy of judgment, as to whether the limb may be preserved, or amputated immediately. Here you take into consideration the cause of the dislocation and its extent; the nature and

situation of the joint; the degree of violence; the constitution of the patient; the probabilities of healing by the first intention or of a suppurative process; the situation and circumstances of the patient, etc. If you determine to save the limb, then you bring the lacerations together as close as possible with strips of adhesive plaster, and if you succeed, you can only regard the case hereafter as a perfect or simple dislocation.

Now the *causes* of dislocation are two-fold: *predisposing* and *exciting—natural* and *incidental.* Among the former may be named the situation of the joint; its extensive surfaces; its laxity of capsule; morbid changes of ligamentous structure; paralysis; destruction of the cartilages; absorption of the bones; muscular action, etc.: as to the latter, a blow may produce luxation of an arthrodial or ginglemoid joint; but muscular action must be concurrent with external force to dislocate an enarthrodial or ball and socket joint.

The symptoms of dislocation are various, according to the variety of the joints affected. In enarthrodial joints there must be either an extension or shortening of the limb. In ginglemoid joints, however, the disproportion between the surfaces is easily ascertained in consequence of their superficial situation. If the dislocation be the head of any large bone, then the shaft must take a parallel direction to that in which the head is placed, therefore you have the limb either approximated to the body or thrown outwards from it; or you may have the head twisted, and then the shaft

follows also, so that the limb may be rotated onwards or outwards; the muscles also which pass over the injured joint will be variously affected, —some must be relaxed, others stretched; the contour of the limb also will be interfered with, where there was a depression, now there is an elevation, where there was a pleasing roundness, now there is an unnatural depression; the action of the limb will be also affected, loss of motion will have taken the place of extensive power of action; the limb may be permanently flexed or extended; or lastly it may have limited capability to be moved, but at the expense of much pain in its exercise.

The general treatment of dislocation. Although perhaps it is better to cure a man empirically than to kill him *secundem artem*, and notwithstanding the wonderful success which has attended the daring attempts of illiterate and unskilful empirics in cases of dislocation,—it is indispensably necessary that all who presume to handle a dislocated limb should know the disposition, power, and attachment of its muscles. Without anatomy what would become of surgery? Indeed there is no part of surgery, having reference to the muscles, which requires more intimate acquaintance with that science, although at first sight it may appear to be otherwise. Next in order of importance to those departments of surgical science which treat of vital organs, as the circulating and nervous systems, and alimentary canal, comes the muscular system, because it not only forms the

most universal, but the most active and powerful of the whole; that is to say, it is the agent of the will, in contradistinction to the others which are obedient to involuntary influence. Now in dislocation we have nothing to do with arteries or nerves primarily; all our relations are to muscles which are agents, and bones which are patients. Hence I think it is apparent that in this department of surgery, a knowledge of muscles and their properties is of first importance.

Having stated that muscular action was the proximate cause of dislocation, we now say that it is also the main difficulty to be coped with in the reduction. The ancients met force with force; "Many or most of their means indeed," says Mr. Pott, "are much more calculated to pull a man's joints asunder than to set them to rights." Moderns have rejected most of these instruments, and so modified others, that they cease to operate upon their former principle, it being in conformity with a new and more rational axiom, "that muscular force should be eluded rather than overcome." A very cogent reason then why you should accomplish by dexterity that which the ancients attempted by force, is that though the bone be dislocated, the muscles do not cease to act, and, what is more, to act almost involuntarily, as though their instinct incited them to resist attempts to move the limb, from an apprehension of its being the source of increased pain and uneasiness to the patient. Moreover, in consequence of the alteration of the position of the head of the bone,

one class of the muscles affixed to its shaft is also endued with increased power, while the other class must be proportionately weakened.

Seeing then that we have in muscular force a powerful antagonist while the two parts of the dislocated joint are at an angle of separation, but that it becomes a considerable auxiliary when the surfaces of the bone are directed into a line with each other, and both classes of muscles are restored to their uniform action, it is the design of the surgeon to bring the parts to this disposition as speedily as possible by a dextrous, gradual, and continued, but not a forcible extension of the limb; which accomplished, the muscles restored to their equal power will, by consent of action, do the rest, and cause co-aptation of the opposed surfaces.

Now as to the mode of extension, let these three principles be borne in mind: 1. That the only extending means to be used are either manual assistance, sheets applied to the limb, or the multiplied pulley; of these the two former are preferable, and the first better than the second; 2. That these instruments or means should be applied at the end of the limb, so that the operation may have a longer lever and greater power; and 3. That extension should always be first made in the same direction which the limb takes at the dislocation; for instance, should the dislocation cause the limb to be thrown at an angle from the body, then the extension should be first performed in that direction; and subsequently the shaft of the bone

must be gradually made to describe the segment of a circle, and the whole bone be thus brought on a line with the joint, when extension ceases to be necessary, and the muscles will become the agents in co-aptation. But here arises the question, "Suppose the muscular action to be too powerful, and quite alive to the endeavours to cause extension, and half-involuntarily contracted to their utmost limits of resistance, what would you do in such a case;—were not the ancients justified then in opposing force to force?" By no means; the remedy is still in your power, without, by undue violence, throwing fresh fuel upon the irritability of the patient, and increasing his pain and anxiety: you know that one system is in a measure dependant upon the other, and especially that which is less is dependant upon that which is greater (as the secretion is under the influence of secerning power); therefore you may reduce the strength of the muscles by detracting the pabulum by which it is supported,—you may bleed from a large opening, in "a full stream and a sudden," until syncope is induced, when you may take advantage of the absence of the muscular resistance, and extend the limb.

Here let me finally state that the three points in the reduction of a bone is, *extension*, which is the active agent; *counter-extension*, which is in fact passive, and means the fixing of the body so that the extension shall influence the affected joint only; and *co-aptation*, which is generally independent of external agency, and caused by muscular contraction.

To this I may add, that after the reduction is effected, it is easily retained by a splinter or a bandage, or by rest without either. Perhaps it is not so well to set aside the use of either of these, inasmuch as the patient may be better satisfied with a little restraint, although in truth it is devoid of real utility.

FRACTURE.

Fracture is the separation of one part of a bone from another; resulting either from external violence or undue muscular action.

Fracture is divided into *three general kinds;* viz.: *simple*, *compound*, and *comminuted.*

Simple Fracture. This may again be subdivided into three kinds, named according to the direction which the fractured portions obtain,—these are the *transverse*, *oblique*, and *longitudinal;** the first of which is most frequent in occurrence, and the last very rare.

In addition then to the two *exciting causes* before mentioned, viz., external injury and muscular action, we may name as *predisposing* or *remote causes*, the situation of the bone and its liabilities to injury, organic changes in its substance producing mollities or fragilitas ossium; to which may be added, rachitis, lues venerea, cancerous affections, scrofula, scurvy, gout, and lastly, powerful muscular contraction.

Symptoms of fracture. The most decided

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* Mr. Guthrie relates cases of this.

symptoms connected with fracture are, *crepitus*, deformity of the limb arising from the two ends of the bone overlapping each other or causing inequality, and shortening of the limb; to these may be added minor and more uncertain symptoms; viz.: pain, incapability of enduring motion, tension, and muscular twitchings from nervous sympathy.

But when we mention these as general symptoms, it must be apparent that as there are various kinds of fracture and numerous differences of situation and circumstances, there must be as a consequence, particular characteristics connected with each individually. Hence there are certain bones, which, though fractured, cannot by reason of their connections sustain any displacement; there are others also which, consequent upon such an injury, do not until a considerable time after cause tumefaction in the soft parts. Again, where there are two bones constituting the hard structures of a limb, as for instance in the leg, and one of them, the tibia, is only suspected to be broken, then no displacement can take place, because the other bone is a natural splint; a perfect crepitus can scarcely be expected to exist, and therefore one of the best evidences is to be afforded by an inequality ascertained upon a critical examination of the anterior spine. But in limbs which have only one cylindrical bone, the fracture is directly ascertained,—the extremity is shortened, the crepitus is distinct, and the deformity is evident.

One or two hints arise from the consideration of

this subject, which are as self-evident as they are important.

1. In ascertaining the nature of an accident, if the deformity and other symptoms be sufficient evidence of a fracture, do not gratify your inclination in causing a crepitus at the expense of the patient's feelings, and at the risk of increasing the inflammatory symptoms.

2. If the limb be considerably shortened, do not take it for granted that this symptom arises from one portion of the bone shelving over the other, but immediately suspect a dislocation also; if you find one, then congratulate yourself upon your discovery before it would have become too late to reduce it; if you do not, then you may be glad in having only one accident to cope with.

3. In examining the inferior extremity to see whether it be shortened, look to it, that the pelvis be straight, and that the anterior superior spinous processes are on a level.

4. Let particular attention be paid to the great prominences of the limbs; to the trocanters (in fractures of the neck of the thigh bone;) to the condyles; to the olecranon, etc.; for these have a very important reference to fractures, though not so much so as to dislocation.

Treatment of fracture. This is regulated by *three general principles:* 1. *Reduction of the fractured portions;* 2. *The preserving them in a state of apposition;* and 3. *The alleviation of all untoward symptoms as they arise.*

1. *Reduction.* In the accomplishment of this,

three particular means are made use of, viz., *extension* on the extremity of the limb which contains the lower or displaced portion of the bone; *counter-extension*, or resisting force upon the upper part of the limb; and *apposition* of the fractured portions.

But although these are mentioned as the three chief means used in the reduction of fractures in general, it is manifest from the variety of circumstances, situations, and characters of individual cases, that they cannot be supposed to be necessary or applicable to all. The differences of the direction of the fracture, the variety of the character of the bone, the position of the portions that have sustained the injury, the comparative absence or different degrees of muscular influence, and the moveability or fixedness of a bone, must of necessity form numerous instances, requiring a moderated use of the three modes of reduction, and some wherein coaptation alone is indicated.

The terms *extension*, *counter-extension*, and *coaptation*, of themselves explain their meaning; it is only necessary to say; 1. That the former is required in all cases where there is an oblique fracture of any bone or pair of bones of a limb, and the broken extremities to any extent overlap; 2. That the extending force should be applied to the *extremity of the limb*, by means of a towel or bandage, whereby the length of the lever is increased, and the power rendered greater; and 3. That the degree of force should not be greater than is necessary to liberate the extremities, and

prevent their grating during coaptation; very little is required in parts where there is but little muscle, and more, where there is only one bone and a great thickness of flesh, as for instance, in the thigh.

Counter-extension is in fact only the passive resistance the surgeon makes to confine the effects of extension to the fractured bone, and is put into practice by a towel or roller, applied to the upper part of the fractured limb, and retained by an assistant.

Coaptation must be accomplished, by making use of the displaced lower portion of the fracture as a lever, and can generally be practised without having recourse to the painful method of kneading the limb at the seat of the injury; this is dangerous, and should be attempted as little as possible, to prevent the splinters of the bone injuring the soft parts surrounding them.

If the fracture should occur in a strong muscular subject, and a considerable degree of contractile force exist, whether caused spasmodically or by the resistance of the patient, then the use of the lancet is always advisable; and when loss of blood has produced syncope, or the muscles have become relaxed, the surgeon will proceed quietly and tenderly to the reduction of the fracture, rather than, by the exertion of force, keep in full opposition the counteracting efforts of the muscles of the injured limb.

Having perfected the reduction of the fracture, your next object is to preserve it in its restored

position; and in doing this you will find the muscles still to be the chief object of attention, since by their disposition it is, that the fracture is either favorably or unfavorably effected. A bone being only a passive organ, and possessing an intrinsic regenerative circulation, all that is necessary for the re-union of a fracture is the close apposition of the two broken portions; but that power which in the first place caused the accident, and then interfered with its reduction after its occurrence, still operates very frequently, to separate the apposed surfaces, and derange the uniting process. Hence it is obvious, that the muscles claim our greatest attention as soon as the fracture is coapted, and the surfaces of the two portions are perfectly equal.

The *position of the limb*, then, must be regulated by the knowledge the surgeon possesses, 1. Of the *attachment of the muscles into the lower portion of the fracture;* 2. *Of those whose bellies cover the seat of fracture;* and 3. *Of those which are connected with the upper part of the injured bone:* Lastly, the two other points in the treatment are: 1. The kind and uses of external apparatus and applications; and 2. The length of time, and the degree of rest required, whether of the broken part only, or of the whole body; and the description of bed most fit to promote the design of the surgeon in its use. The position of the limb is best regulated, when all or most of the muscles operating upon the lower portion of the fracture are in a state of

relaxation; when the bellies of the muscles upon the seat of fracture and the supporting apparatus are uniform at all points; when the weight of the body or part of the body is removed from the injured limb; when the bed is not too soft to yield to incumbent pressure, nor too hard to abrade the skin; and when no opportunity is afforded to the muscles, or any external causes, to interfere with a state of perfect quietude by reason of inadequate or partial support.

The bandages also and external applications will be most advantageous which adequately effect these material points of judicious practice,—1. To subdue and repel inflammation, and preserve the functions of the skin; 2. To give an uniform and general compression to the muscles of the whole limb, and thereby moderate and repress irritable spasmodic action; and 3. To maintain the reduction by means of splints, which prevent the motion of the fractured bone, and the separation of one part from another.

Now as to the first of these, viz.—*external medicinal applications*, they must not be of an irritating nature, nor when applied, liable to change or decay; nor must they adhere to or soil the skin and bandages; of these, soap plaster or evaporative lotions are most commonly used.

In reference to the second means before mentioned, it is evident that the *bandage* should perform its intentions without submitting the limb to the pain and danger of occasional motion, which would indeed combat the very intention of its use, and the

means whereby re-union is effected: hence, in fractures of the inferior extremities, especially where the muscles are of great weight, numerous, powerful, and large, it becomes a matter of first consequence after the apposition of the bone and the patient has assumed a recumbent posture, that the limb should be kept perfectly motionless at the time the surgeon occasionally removes the bandages to inspect; wherefore a particular kind is used, called the *eighteen-tailed bandage*, which consists of a longitudinal strip of linen designed to extend along the outer side of the limb, and to which are appended shorter pieces, stitched to it at acute angles, whereby they may be brought obliquely over the limb and made to adjust themselves to its different dimensions without derangement, and are capable also of removal for the surgeon's inspection without the necessity of using the slightest motion. Scultetus bandage, in universal use in France, differs only in permitting any part of the series of oblique slips to be removed when soiled in consequence of their being separate, or but slightly appended to the longitudinal portion. As for fractures of the upper extremities in general, the common roller is all that is necessary; different modes of deligation being practised according to the parts which are the seat of injury; this will be a point of consideration when treating on particular fractures. Too much stress cannot be laid upon the inutility, nay danger, of tight bandaging: we may say, that in general practice much more mischief is

done by tight bandaging than good by its use at all; in ulcerous legs and cases of anomalous swellings, some of which issue in collections of pus beneath fascia, the very pressure of the roller has aggravated rather than diminished the affection. Here if the bandage be put on tightly at an early period after the occurrence of the accident before the inflammation shall appear and the tumefaction come on; then when it does, as indeed it must, perhaps the patient informs the surgeon of the accession of those symptoms, and complains of the restraint of the bandage; the surgeon essays to remedy this and sends a lotion; the bandage is rendered wet and contracts still tighter; the symptoms are aggravated rather than lessened, and the surgeon subsequently has the mortification, and the patient the pain of submitting to the removal of the apparatus in order that it may be more scientifically readjusted.

In reference to the third point of practice, the *application of splints*, one or two principles are to be borne in mind. 1. That the design of their use is to keep the bone motionless, as well as also the limb at large, wherefore one should extend the whole length of the limb—the other over the lower joint of the bone. 2. To keep the extremities of the bone in apposition, and prevent preternatural contraction of the muscles overlapping of the two portions and shortening of the limb; and this is effected by applying the splints when the bone is coapted, and fixing them some space above and below the seat of fracture,

and particularly to the parts of the limb above and below the joints of the fractured bone. And 3. In the application of splints, to guard against compression and abrasion of the skin by the use of tow or wool between them and the depressions surrounding the eminences of the limb and joints, making thereby an equal surface and everting the consequences liable to result from the contact of the hard unyielding splints with the prominent extremities of the bones.

This practice I believe is all that is meant by the use of "continual extension and counter-extension," mentioned by several surgeons of eminence; for surely to stretch the limb to a point beyond its natural length would be to court the resistance of the muscles, and not to counteract them; and to continue at every fresh dressing a further extension, be it ever so gradual and insensible, must necessarily interfere with and antagonize the process of regenerative formation at the very seat of fracture, which of course can be the only part capable of yielding to force however modified. It is well therefore for the surgeon to be certified that the coaptation is complete, and the limb of the same length as the other when he first sets the bone, and if he should find great difficulty let him not spare the use of the lancet; it will be better for him to do his work on a fainting man with perfect accuracy, than put up the limb into the apparatus unfit by reason of the overlapping of the broken portions to be re-united, until by "extension and counter-extension," repeated at

occasional dressings, the dislocated portions are approximated to each other at the expense of pain, and the undoing of the previous efforts of nature.

There are contingencies frequently attendant upon fracture which require also attention from the surgeon.

Frequently there is very great contusion, the limb looks blackened, glazed, and swollen, and the scarf skin is raised into little pellicles containing lymph; these should be punctured, and the parts covered with emollient applications such as cer. plumb. superacet, cer. sapon. etc.; or leeched, and then bathed with poppy head fomentation; or treated with evaporating spirit lotions; or dressed with opiate applications, just as the surgeon sees fit. Sometimes there is extravasation of blood more or less in quantity; this will be absorbed by the lymphatics in course of the process of cure, and will require no assistance from the surgeon; let not however, either the pellicles of lymph or the blackness of the limb from extravasation, lead the surgeon to suppose that gangrene has supervened in either case, nor in the latter, where the discharge of blood into the cellular membrane is very extensive, let not this interfere with the surgeon's being very accurate as to the perfect reduction of the fractured parts.

Dislocation sometimes accompanies a fracture, and when it does, if it be not reduced directly, that is to say before the union of the fracture, it very seldom is after. In ginglemoid joints and arthrodial connections the facilities of reduction

are widely different, and the accomplishment of the operation will be more or less successful and satisfactory according as the joint is affected by the muscles :—muscular power which, when the bones are in a state of natural apposition, forms the strongest buttress of the joints, is the most formidable antagonist the surgeon has to cope with in his endeavours to replace dislocated bones which possess usually a wide latitude of motion.

Compound fracture. This term is used to signify the existence of a wound in the skin communicating with the seat of fracture, and caused by the protrusion of the fractured end, or else by a musket shot, which entering the skin, takes a direction toward the bone and fractures that in its course, making a sinus through the limb.

Now in this case is required one of the greatest efforts of professional judgment—a question arises involving the life or death of the patient—the fame or ruin of the surgeon; it is this,—shall the limb be saved or amputated? To make an accurate opinion on this subject, it is right to look at past experience but not to trust to it alone; to inquire how the accident occurred, and what means caused it; to ascertain whether the fracture be comminuted; to learn the extent of the laceration of the soft parts; to judge of their vitality, whether or no they are of that class which possess a vigorous circulation, such as muscles and cellular membrane, or of that other class which naturally are endued with less life, such as tendons and ligaments; or whether either are so lacerated as to be

incapable of sustaining vitality; to take into consideration what part of the bone is fractured, whether at the centre of the shaft, or near to and involving the articulation; and lastly, to decide, having in view the facilities afforded by the circumstances and situation of the patient favourable to perfect rest on the one hand, or on the other, the disadvantages of his being in a crowded hospital liable to the accession of fever, or in a camp in danger of sudden removal. In addition to this, the question obtains greater importance inasmuch as it requires instant decision, and all the determination, collectedness of mind, and address, to bring the patient into submission, and to carry the object of the surgeon into effect.

Having made your decision, we will suppose that you consider the lacerated parts capable of sustaining life, and the limb fit to be preserved. The first object will be to restore the protruded bone if such be the case; and this may be accomplished by an extension of the limb, and if this should fail, by a relaxation of it; the first will generally do it inasmuch as the upper part of the fractured bone is that which protrudes; but if this should only brace the soft parts more tightly around the bone, if the wound should be but just large enough to admit of its protrusion but not of its reduction, and especially if the fracture be pointed and oblique, then surgery acknowledges two modes of relief, viz., the sawing off of the point of the bone, or the dilatation of the wound itself. To determine the most eligible

of the two, it is only necessary to ask the question, which has the most vitality, and which is capable of the earliest regeneration, the bone or the soft parts? of course the surgeon immediately answers by preferring the scalpel to the saw in most cases where the use of one or the other is considered requisite. The second point in the treatment of a compound fracture is to remove all extraneous and offending bodies, such as particles of clothes, dirt, or detached spiculæ of bone; taking care however, not to intermeddle with the larger fragments of bone if they be supposed capable of enduring life, or in any way causing increase of pain and irritation by poking into and disturbing the interior of the wound; for remember, you have determined on the attempt to preserve the limb, and this decision implies that you are of opinion that all the injured parts are capable of sustaining life. The third point is the reduction and apposition of the bone; this is accomplished by the same means as in a simple fracture; but let not extension be made too greatly to the manifest injury of the contused parts and the increase of the patient's pains. The fourth point in practice is directed to the suppression of inflammation, the relief of all untoward symptoms, and the endeavour *to heal the wound by the first intention:* this must be done by the application of anodyne and spiritous lotions, bringing the lacerated parts together with strips of adhesive plaster, and the use of the *eighteen-tailed bandage* instead of the swaithe, for the sake of facility in dressing the wound. Failing in pro-

ducing union by the first intention, the fifth point is the appropriation of such remedies as are calculated to facilitate the easy suppuration of the wound; these are, an accurate position of the limb; emollient fomentations, and anodynes; enlargement of the wound to prevent the lodgment of pus; or the formation of new wounds by the knife at the depending part of the limb, taking care that as little as is needful be cut; the promotion of the discharge of exfoliated bone, and all extraneous bodies; frequent evacuations by stool; generous diet; and occasional small bleedings when fever presents.

The sixth point is directed to the treatment of gangrene if this should take place. The surgeons of the last century, of whom Mr. Pott may be considered one of the chief who wrote on the treatment of mortified limbs after compound fracture; these have laid it down as an universal rule admitting of no variation, that amputation of a gangrenous limb should never be undertaken until a line of separation between the living and dead structures has been distinctly made out. Moderns hold the rule but admit of exceptions; that is to say, they deem it requisite to amputate where the gangrene is the result of external injury, such as compound fracture from gun-shot, even before the line of separation has been made, from a consideration, that if the exciting cause be removed then the effect will cease—that as nature instinctively feels her inability to preserve the mutilated limb, she sets up her separating action, and that

surgery is fully justified in rendering her assistance. "When gangrene results from mechanical causes and the patient's life is in danger, amputation must be performed without waiting till the disorder shall have ceased to extend." *Baron Larrey.*

But we are supposed now to be considering a case where there was not at first sight the evidence of the incapacity of nature to preserve the limb, but one where subsequent causes, perhaps the patient's situation and habit of body, have been unfavourable and a partial sloughing has resulted. Here the treatment is of two kinds, topical and constitutional; the former should consist of emollient warm applications, such as the common or barm-poultice, while everything that is stimulating should be particularly avoided;—the scalpel must be set aside, and nature allowed herself to promote the separation betwixt the living and the dead, whilst the surgeon assists to appease pain and irritation, and to prevent the spread of inflammatory action: as to the latter kind of treatment, it must be regulated by the constitution of the patient;—is he robust? then antiphlogistic measures are necessary,—is he weak? then tonics, and particularly bark and nourishing diet is prescribed; while in both cases the functions of the alimentary canal must be kept unimpaired by the occasional administration of saline purgatives.

Process of union.—The theories which have obtained in the schools of medicine during the last and former centuries as to the mode of regeneration of new bony matter in a fracture,

have become the subjects of just and profitable criticism by later surgeons. The notion of the induration of a cementing fluid, supposed by the ancients to be secreted from the fractured ends,—or Duhamel's opinion that regeneration of bone was produced by the periosteum,—or Haller's that an unorganized lymph became converted into an organized body,—these have all long since been exploded, and conjecture more probable, partly supported by facts and otherwise by arguments which appear conclusive, serve to convince us that modern surgeons are nearer the truth than their progenitors, if indeed they have not explored the matter to the utmost extent to which the human understanding is capable of reaching.

There is an analogy observable in the union of all structures in the human frame, and a strong one between the union of a breach in the soft parts and the formation of a callus in a fracture of a bone. Whereas in the former case there is a discharge of blood from ruptured vessels which upon its subsidence is succeeded by the secretion of a glutinous jelly-like fluid; so in a fracture there are the same results produced by the same immediate causes. Precisely as there is in the curative process in the former case a deposition of granulations of coagulable lymph or fleshy matter between the lips of the wound, so in the latter case we have the same phenomena with subsequent deposition of cartilage which becomes the nidus for bone progres-

sively laid down in its substance in the same manner as at the period of its primitive formation. Connected with this, we have the gradual diminution and subsequently total obliteration of the interior medullary cavity, a complete ossification in all the cartilaginous nest, the union of the periosteum and soft parts in an indistinguishable combination, and the existence of a swelling—partly osseous and partly membranous—the result of arterial deposit; lastly, we perceive the setting in of interstitial absorption producing a gradual removal of the swelling, a remodelling of the external surface to its primitive symmetry, a hollowing out of the medullary cavity within, the re-establishment of the medullary membrane, and the restoration of the periosteum to its uniformity and natural distinction of structure.

If then it be proved that the regenerative process is similar to the original growth of bone, it necessarily follows, that the younger the subject is the more easily will the fracture unite, and that with very aged people it is not a matter of surprise should the injury remain disunited; neither is it a wonder, that fractures occurring in cases suffering from lues venerea, scrofula, or scurvy, should be affected with irregularity and protraction of the growth of new bone, or a prevention of its formation altogether: neither again where necrosis, or abscesses, or caries, or the presence of splinters, or the suppuration of the soft parts adjacent, prevent the complete deposition of a callus: and lastly, it is not singular that the absence of rest,

indisposition of the limb, a vitiated atmosphere, a weak constitution, or the influence of intemperance, should so operate as to cause callosity of the extremities of the bones without their union, and the formation of an unnatural or *false joint*.

In the case of this serious inconvenience which would render permanent a temporary accident, surgeons have suggested and carried into execution several plans, in the majority of which they have been so successful as to warrant the recommendation of an attempt being made wherever the situation of the accident is favourable and the constitution is not suffering from the existence of any universal disease; one practice is to cut down upon the bone and abrade the surfaces, and then treat the case as a compound fracture (White); the other is to pass a seton betwixt the fractured ends (Dr. Physic); utrum horum etc. Doctor Physic's is the latest of the two.

In conclusion, let us revert to a statement made in a former part of this lecture, that "bone consists of animate and inanimate matter." The truth of this would at first sight appear self-evident, although after all the latter term must be used *relatively*. The osseous or earthy constituents are, contrasted with the membranous and gelatinous portions, comparatively inanimate; so that those must not be misunderstood who use this term thus, and be forthwith held up as advocates of the *actual combination* of perfectly dead matter with living structures.

On the one hand we are furnished by some with several arguments in favour of the vitality of the earthy particles, the chief of which may be comprised in the two following:—1. As the *blood* is the *life* of man, and is described as a circulating magazine of vitality, it is presumed that all its secretions are modified with life also; 2. That were the phosphate of lime dead matter it would operate just as other extraneous substances do in the soft structures, by causing inflammation and an effort of nature to throw it off.

Again on the other hand, there are found those who still maintain the old position, and are carrying on a defensive warfare against the attacks and innovations of what they consider to be new-fangled theories. They also possess what appear to be arguments in favour of their till lately never-gainsayed opinion. They say, that analogy furnishes many examples where animate and inanimate matter exist in a state of combination; as for instance, in the corals, the shell of fishes, the pearls and scales of the oyster, the calcareous deposits and incrustations of the crab, and in the human subject also, the enamel of the teeth, and the calculous concretions within joints and other cavities. They contend, in contradiction to those who advocate the first-mentioned argument, that the blood is not *altogether* a vital fluid, and that it contains many particles of matter which are palpably dead and unfit for the purposes of nature,—that it is in fact the very *vehicle* by which these particles find their exit from the frame by excretive organs which are

appropriated to it for this express purpose. They state that *all matter has some kind of organization*, and therefore it does not imply necessarily that that must be *vital* which is *organized.* They hold that as the soft structures of bone are among the lowest modifications of vitality, and are naturally so exceedingly insensible and unexcitable, it is reasonable to conclude that *organized inanimate matter* may exist in combination with it without producing any unpleasant results, just as a polypus clings to the rock, or a coraline zoophite within its self-reared edifice. Lastly, that in old age, when the susceptibility of the various structures is weakened, we have nature filling up the interstices of the walls of canals and cavities with lime, which can neither be said to be animate or to require vitality, because the power to cause living excitement is lost, and therefore the system makes an attempt to endure by strengthening those structures with unyielding earth, which hitherto had been possessed of reacting elasticity.

It is needless to pursue the subject further, but will terminate its consideration with the words of Bèclard, which will serve to set the subject fairly before you, whose place it shall be to receive or reject as appears most consistent with the conclusions of reason. " La fibre osseuse est donc une fibre très analogue à la fibre cellulaire, mais en different par la trèsgrande quantitè de substance terreuse qui entre dans sa composition. On s'est fait diverses ideés sur la nature intime de cette fibre. Celle qui est le plus généralement

ise consiste à considérer le tissu des os comme ssu organique aréolaire comme les autres, mais enant de la substance terreuse dans les cavités mement étroites, a peu pres *comme l'eau est posée dans le tissu d'une éponge humide.* tres regardent l'os comme un mélange intime ne combinaison de gélatine et de phosphate ire. Mascagni regarde ce tissu comme formé aisseaux absorbans remplis de phosphate de x. Ce sont autant d'hypothèsis qui ne reposent aucun fait, ou plutôt qui sont contraires aux

On ignore toutefois dans quel rapport t se trouve la substance terreuse avec la ance organique des os." — Anatomie Géné- par Bèclard.

THE

SURGICAL AND DESCRIPTIVE ANATOMY,

OF THE

BONES, LIGAMENTS, AND JOINTS.

CHAPTER II.

THE *natural division* of the human skeleton is the same as that of the body at large, which comprises three main and distinguishing portions designated the HEAD, TRUNK, and EXTREMITIES: to which science has appended other and more particular distinctions partly illustrative of their office situation and character, and partly arbitrary, which are used either from a want of convenient terms, or as the result of imagination.

It is however fit, that every organ of the human body should possess a name, and therefore now that such universal patronage is afforded to the farfetched nomenclature of the ancients, and such indisposition is evinced to receive the more appropriate descriptions of the French, we are not disposed to quarrel with the terms, but shall endeavour to accompany their use with such details

of the position and character of the parts referred to, as will set aside the possibility of inaccuracy or misappropriation.

HEAD.

The *head* is sub-divided into two parts:—

1. The *cranium*, which consists of eight bones, whose office it is to form a case for the brain, and to constitute the superior part of the face and nose: and

2. The *face*, which consists of twelve pairs of bones, and two single ones, whose offices are,—to form the seats for the senses of sight, hearing, and smelling, the agents in eating, the vaults of the voice, and the countenance—the expressive index of the human mind.

OF THE CRANIUM.

The *cranium* consists of *eight* bones; they are as follow:—One os frontis, two ossa parietalia, one os occipitis, two ossa temporalia, one os sphænoidale, and one os ethmoidale. The six former are called *proper*, because they alone have to do with the formation of the calvarium, while the latter are considered *common*, inasmuch as they constitute parts of the face.

The *general character* of the head is *spherical*, the cranial bones in the aggregate forming a *barrel* and not an *arch*, as has been stated: a *section* would describe an *arch*, but the *cavity of the skull* itself is a *cone*.

The most frequent *form* of the individual bones

of the cranium, is that of a *flat* bone, each consisting for the most part of two tables, of which the outer, or that covered by the pericranium, is the thickest, and the internal, or that opposed to the brain, is the densest, (called tablea vitrea) between these is an internal cancellated structure termed diploë.

The most frequent mode of *connection* used in the structure of the skull is *suture*, which consists of the reciprocal inter-receptions of spiculæ of certain two bones into intimate coaptation with each other.

The head is developed very soon in the embryo, that is to say, when the pulpy nervous system is demonstrable; and it is perfected to such an extent as will permit the adaptation of the head to the vaginal and pelvic cavities at the period of delivery; and it is further completed when the mental faculties are in a state of active excercise, *so that it shall be moulded to the brain during the period of education.* The changes that afterwards occur affect the organs of the senses, perfecting them at first, and then gradually, with the approach of old age, diminishing them until the individual is reduced to a state analogous to second childhood.

OS FRONTALE.

Situated at the anterior part of the cranium, and constituting the prominence of the forehead.

Shape. *Concave* internally, to contain the cerebrum; *convex externally*, to give prominence to the forehead. It is resembled to a clam shell.

PROCESSES. *Fifteen situated externally* :—

Two *eminentiæ frontales*. These are two tuberosities forming the centres of original ossification, and the most prominent parts of the forehead ; they are nearly superficial, being only covered by the common integuments occipato frontalis and pericranium : they form the anterior buttresses to the skull.

Two *external angular* processes, forming the external bases or pillars to the arches of the orbits.

Two *internal angular*, forming the internal pillars of the arches of the orbits.

Two *superciliary ridges*, stretching in an arched form between the external and internal angular processes ; these are called also *orbital margins*, and are covered with the substance of the eyebrows.

Two *p. orbitales*, arching backwards from the superciliary ridges, and forming the roofs of the two orbits ; these constitute also a portion of the base of the skull, and support the anterior lobes of the brain ; the bone here is exceedingly thin and pitted by the convolutions of the cerebrum. If in a fall the head is forcibly projected against any hard body, and the calvarium is not fractured at the seat of the blow, then very frequently the impetus is transferred to the orbital processes, and these being slight sustain that injury.

Two *liniæ temporales*, stretching upwards and backwards in curved lines from the external angles ; these give attachment to parts of the temporal fasciæ.

Two *supra orbitar processes*. Above the superci-

liary ridges, indicating the site of the frontal sinuses.

One *p. nasalis.* An angular spicula of bone between the internal angles, supporting the two ossa nasalia, and intervening between them and the septum narium.

One *situated internally* :—

One *internal perpendicular spine*, seen on the internal concave surface of the bone; it commences immediately behind the nasal process, and loses its elevation about half way up the bone; it indicates the lower part of the median line of the skull, and is continuous with the *crista* galli, with which it gives attachment to the anterior part of the *falx major of the dura mater.*

Foramina. Two *proper* :—

Two *foramina supra-orbitaria.* Sometimes only notches, situated near the inner part of the superciliary ridges, or at the junction of the middle with the inner third of these ridges; they commence in the orbit, and transmit the *frontal arteries and nerves* to the parts on the forehead, to which they are distributed.

Five *common foramina* :—

Two *f. orbitaria interna antica.* These are seen by looking into the inner side of the orbits, and found in the junction of the orbital processes of the frontal and ethmoid bones: they transmit the *nasal twigs of the ophthalmic branches of the fifth pair of nerves*, which immediately enter the cavity of the cranium through these foramina, course forwards on the cribriform plate of the ethmoid bone,

and then dip downwards into the nostrils through the most anterior of the cribriform foramina of the same bone.

Two *f. orbitaria interna postica.* These are posterior to the former, in the same junction of bone. They transmit small *nasal arteries* to the nose; but are sometimes altogether wanting.

One *foramen cæcum*, (internally.) Situated between the roots of the internal perpendicular spine and crista galli; it contains sometimes *a small vein* and a *process of dura mater:* this vein comes from the nose and forms the commencement of the longitudinal sinus.

PECULIAR PARTS SITUATED EXTERNALLY:—Two *fossæ temporales.* Beneath the liniæ temporales and behind the external angles; these give *origin* to the *temporal muscles.*

Two *sinus lachrymales.* Deep depressions within the orbit on the inner sides of the external angles. These lodge the *lachrymal glands.*

Two *fossæ trochleares.* Smaller fossulæ within the orbit on the external sides of the interior angles. These are formed by the *middle tendons* of the *trochleares muscles* which are here held against the orbital processes by ligamentous bands in form of pullies.

Two *sinus frontales.* Cavities hollowed out of the bone behind the supra orbitar processes; these are lined by the *schneiderian membrane*, and contain *air*, — being continuous with the meatus medius nasi by means of the anterior ethmoidal cells. It forms an appendix to the organ of the voice, hereafter to be adverted to.

PECULIAR PARTS INTERNALLY:—One *fossa cerebralis.* Constituting the inner concavity of the bone; this receives the *anterior lobes of the brain.*

One *sulcus longitudinalis.* A groove continuous with the internal perpendicular spine, and like that on the median line; it lodges the *superior longitudinal sinus.*

Fossæ pacchionii. Several irregular depressions situated laterally to the sulcus longitudinalis; they are formed by those bodies called *pacchionian glands*, which are no doubt structures in lieu of, or appended to, an absorbing system: they are however sometimes wanting altogether.

Sulci arborescentes. The depressions formed by the ramifications of the *meningæal arteries* of the dura mater.

Hyatus ethmoides. The space seen in the disconnected bone between the inner edges of the orbital processes, which is occupied in the connected state by the ethmoid bone.

Cellulæ ethmoideæ. Partial depressions on the inner edges of the orbital processes rendered complete cells by the body of the ethmoid bone, and lined like the frontal sinus with schneiderian membrane.

REGIONS. If you divide the frontal bone into *regions* for the sake of description, then you have *four;* viz.: the FRONTAL the anterior,—ORBITAL and NASAL the inferior,—and TEMPORAL the lateral,—*externally;* and the CEREBRAL, the *internal* surface of the bone.

In the FRONTAL REGION observe the *convexity;* the two *eminentiæ frontales;* the two *supra orbitar processes;* two *supra orbitar foramina;* and two *orbitar margins.*

In the ORBITAL and NASAL REGION observe the *orbitar process; internal orbitar foramina, anterior and posterior; internal angular process; sinus lachrymalis; fossa trochlearis; nasal process; openings of the frontal sinuses; cellulæ ethmoideæ; and the hyathus ethmoides.*

In the TEMPORAL REGION observe the *external angular process;* the *linea temporalis;* and *fossa temporalis.*

In the CEREBRAL REGION observe the internal concavity called *fossa cerebri; internal perpendicular spine; sulcus longitudinalis; foramen cæcum; fossæ pacchionii;* and *menengial,* or *arborescent sulci.* Turn to the description and learn after this manner if you like.

FŒTAL STATE. In the fœtus this bone is divided into two equal parts. The upper or coronal angles of which are rounded off and their place supplied with a membrane, which hyatus thus formed by the frontal and parietal bones, is termed the anterior fontanelle or bregma. The frontal sinuses are absent as well as the cellulæ ethmoideæ; and the nasal process is imperfect.

CONNECTIONS. The upper circular margin of the frontal bone is connected to the anterior margins of the two parietal bones by the *coronal suture. Observe that the upper part of the frontal bone overlaps the parietals, and at its lower part is in its turn overlapped by them.*

That part of the bone behind the external angles is connected to the alæ majores of the sphœnoid bone by the *sphœnoidal suture.*

The *transverse facial suture* connects the under surface of the bone after this manner :—externally and anteriorly, the external angular process of the frontal to the superior orbital process of the malar ; more internally, the external edge of the orbital process to the upper edge of the orbital process of the sphenoid bone ; and posteriorly, the posterior edge of the orbital process to the anterior edge of the ala minor of the sphenoid bone nearly its whole length ; posteriorly and internally, the internal edge of the orbital process to the upper edge of the orbital process of the ethmoidal bone ; anteriorly and internally, the orbital process to the upper edge of the lachrymal bone ; and most anteriorly, the internal angles are rivetted upon the nasal processes of the superior maxillary bones. Upon the nasal process and parts contiguous, the nasal bones are implanted ; and *this process is received between those bones and the septum narium.*

General remarks. By a review of this bone, it is seen to form considerable parts of the cavities for the brain, the orbits, the nose, and of the temporal fossæ. To the first is devoted the whole of its *inner* concave surface ; to the second, the whole of its *under* concave surface ; to the third, a considerable sinus or cavity in its *interior ;* and to the fourth, the whole of its *outer* concave surface. This bone is frequently trephined for fracture with

depression owing to its exposed situation, it however possesses bulwarks in its frontal eminences and in its arched form,—the shock of a fall or blow being transmitted to the angular pillars of the bone. The practice of trephining on the frontal sinuses is not recognized; in extreme cases however it is justifiable, taking care to trephine the *inner* table with a smaller modiolus than that used upon the *outer*. The development of the frontal sinuses and the erection of the forehead are consentaneous with puberty.

OS PARIETALE.

Situated at the lateral and superior part of the scull. *Shape*, quadrangular; convex externally and concave internally; and possessing four *angles* and four *margins*.

Angles:—The anterior superior or *frontal* angle is rectangular in shape.

The posterior superior or *occipital* angle is more obtuse.

The anterior inferior or *sphenoidal* angle juts down into the temporal fossa, is the *longest* and most *acute*, and is termed therefore the *spinous* process.

The posterior inferior or *mastoidal* angle is, properly speaking, a surface having the appearance of being chipped off, and is therefore most *obtuse*.

Four margins:—

Superior margin called *saggittal* in compliment to the suture here existing. This is the longest edge of the bone.

Anterior or *coronal* margin is connected to the frontal bone; this margin is next in extent.

Posterior or *lambdoidal* margin, connected to the occipital bone, ranks third in extent of surface.

Inferior or *semilunar notch*, so called from its shape, and *squamous* from its character, having the appearance of a scale of bone, which is overlapped by the temporal bone through the medium of the squamous suture. This is the shortest of the four margins.

PROMISCUOUS PARTS SITUATED EXTERNALLY :— One *processus* or *eminentia parietalis*. The centre of the bone and first seat of ossification. This forms the same defence for the side of the head as the corresponding process of the frontal bone does to the forehead.

One *linea temporalis*. A continuation of the linea temporalis of the frontal bone, arching across below the above process, and giving attachment to the fascia temporalis.

One *fossa temporalis*. The somewhat concave surface of the bone below the linea temporalis, for the origin of the temporal muscle.

Striæ squamosæ. Ridges to rivet the temporal and parietal bones together; these are seen in the squamous margin.

Foramen parietale. Frequently seen about an inch from the occipital angle. It is generally occupied by an insignificant vessel passing to the scalp from the dura mater.

PARTS SITUATED INTERNALLY. *Fossa cerebri*. Its internal concavity at large.

Sulcus longitudinalis. Continued from the frontal bone, and formed by the junction of the two parietals; it lodges the middle part of the longitudinal sinus; its margins are elevated to give attachment to the falx major.

Fossæ pacchionii. Depressions found occasionally as in the frontal bone by the side of the above sulcus for the pacchionian glands.

Canalis spinosus. Seen in the sphœnoidal angle, it conducts the spinous artery of the dura mater.

Sulci arborescentes. The multiplied depressions on the surface of the bone formed by the above-named artery; called also *meningeal.*

Sulcus lateralis. On the inner side of the mastoidal angle; this is filled by the great *lateral sinus*, which passes over it here.

REGIONS OF THE PARIETAL BONE. These are *two;* viz., the EXTERNAL and the CEREBRAL.

In the *external* will be seen, beside the four angles and four margins, the foramen parietale; linea temporalis; fossa temporalis; and striæ squamosæ.

In the *cerebral*, (beside the four angles and margins) fossa cerebri; sulcus longitudinalis; fossæ pacchionii; sulcus lateralis; canalis spinosus, and sulci meningeales.

In the description of this bone; after the method of this book, there is scarcely any difference from that adopted in the demonstration of regions or surfaces.

FŒTAL STATE. This bone is complete in the fœtus, as far as form is considered; its eminentia

is very prominent, and the linea et fossa temporalis are not existing. The frontal and occipital angles are also wanting, whereby the fontanelles are formed, which are the spaces between the bones filled with membrane.

Connections. All its anterior edge is connected to the frontal by the *coronal* suture: all its upper edge to its fellow, by the *saggittal* suture; —all its posterior edge is connected to the occipital bone by the *lambdoidal* suture: its sphenoidal angle is connected to the ala major of the sphœnoid bone by the *sphœnoidal* suture; its semilunar notch to the squamous portion of the temporal bone by the *squamous* suture; and its mastoidal angle to the mastoid process of the temporal bone by the *additamentum suturæ squamosæ.*

General remarks. The same observations in reference to trephining apply to this as to the frontal bone. It is justifiable under urgent circumstances to trephine in the fossa temporalis, by separating the muscle from the bone, and cautiously using the instrument on account of the variable thickness of its substance. It is also consistent to trephine upon the longitudinal sinus and upon any one of the cranial sutures. It is not proper to trephine upon the sphenoidal angle of this bone, because of the canal containing the spinous artery, unless there be evidences of great extravasation. Only one muscle takes its origin from this bone and that but partially, the temporal; and another passing over it is attached slightly to it, the occipito-frontalis.

OS OCCIPITALE.

Situation. At the posterior and inferior part of the cranium.

Shape; trapezoid: being concave anteriorly or internally; and convex posteriorly or externally.

PROCESSES *situated externally:—*

One *tubercle.* A process of bone situated midway between the apex of the bone and the foramen magnum: it gives attachment to the ligamentum nuchæ.

One *superior transverse ridge.* An arch of bone stretching outwards from the tubercle to the circumference of its sides; it separates the upper smooth from the lower rough and pitted surface; it gives attachment to two muscles—*origin* to the occipto-frontalis and trapezius.

One *inferior transverse arch* stretches midway between the superior arch and the foramen magnum: it is formed in the interstice between those muscles which are inserted into the fossæ above and below it, and not expressly into it as erroneously asserted.

One *external perpendicular spine.* A ridge of bone extending from the tubercle across the inferior transverse arch to the foramen magnum; it merely indicates the interstice between the muscles inserted into the fossæ on either side of it.

Two *condyloid processes*, situated laterally to the foramen magnum, having their anterior parts more approximated to each other than their posterior, being lined with articular cartilage and shelving so that the inner edges are the deepest;

the surfaces of these condyloid processes look downwards and outwards, and fit into the articulating processes of the atlas (which look upwards and inwards) so that a compound ginglemoid joint is perfected.

Two *lateral processes*, situated externally and laterally to the condyloid; these must be looked at on their cranial aspect when two sulci will be discovered which receive the terminations of the laternal sinuses.

One *basilary process* (or *cuneiform*,) stretching upwards from the anterior part of the foramen magnum, and constituting a part of the base of the cranium in connection with the basilary process of the sphœnoid bone, with which at maturity it is one in substance. At its connection with the condyloid processes, or in front of the foramen magnum, it is flat and expanded, but is seen gradually to thicken and collect its fibres towards its extremity. It gives *origin* to the constrictor pharyngis medius, and *insertion* to the recti antici.

One PROCESS, *situated internally*:—

Internal crucial spine, dividing the inner part of the bone into four unequal cavities. Its upper limb gives attachment to the falx major; — its lower limb to the falx minor; — and its two lateral to the tentorium.

FORAMINA. Five *proper*:—

Foramen magnum, the largest foramen in the skull; bounded anteriorly by the basilary process, and laterally by the two condyloid. It gives *egress*

to the medulla spinalis and membranes, the anterior and two lateral spinal arteries; it gives *ingress* to the two vertebral arteries, the posterior minor arteries of the cerebellum and nervi spinales accessorii willisi.

Two *foramina condyloidea antica.* These open anteriorly to the condyloid processes and give *egress* to the two lingual nerves, or ninth pair.

Two *f. condyloidea postica.* Frequently absent, but when existing found behind the condyles; they transmit small veins from the surface of the cranium to the lateral sinuses.

Four *common foramina:—*

Two *f. lacera postica in basi cranii.* Formed between this and the temporal bones; each gives egress to the commencement of the internal jugular vein, par vagum, glosso-pharyngeal branch, and nervus spinales accessorius willisi.

Two *foramina mastoidea postica.* Common to the bone and the mastoid process; frequently altogether wanting or only one found to exist; each transmits a vein from the scalp to the lateral sinuses.

Fossæ. *Seventeen, situated externally:—*

Two *f. complexi*	Formed between the superior and inferior transverse ridges, the complexi being the largest and situated most internally, the splenii next in size and situation, and the obliqui most externally.
Two *f. splenii*	
Two *f. obliqui*	

Two *f. rect. cap. post. minores*
Two *f. post. r. cap. p. majores*
Two *f. rect. laterales*

All these situated between the inferior transverse arch and the back of the foramen magnum; the minores being innermost and the laterales most outwardly situated.

Two *f. rect. cap. ant. minores*
Two *f. for insert. r. c. ant. majores*
One *fossa* or sometimes *tubercle* for the attachment of the *constrictor pharyngis medius*

These are situated on the under side of the basilary process and anterior to the foramen magnum; the minores are most inwardly —the majores outwardly, and the attachment of the constrictor anteriorly.

Five *fossæ, situated internally:*—

Two *f. cerebrales.* Above the lateral limbs of the crucial spine. These lodge the posterior lobes of the brain.

Two *f. cerebelli.* Below the lateral limbs. These lodge the two lobes of the cerebellum.

One *fossa basilaris.* The upper concave surface of the basilary process. On this lie the medulla oblongata, the vertebral arteries, and nervi spinales accessorii.

Sulci, six in number, all situated *internally:*—

Two *sulci laterales.* In the lateral limbs of the crucial spine for the lodgement of the lateral sinuses.

Two *sulci basilares.* On the side of the basilary process for the inferior petrosal sinuses.

One *s. longitudinalis.* This engages the *superior* limb of the internal crucial spine, and is formed by the terminating portion of the longitudinal sinus.

One *s. occipitalis.* Sometimes found in the *inferior* limb of the crucial spine, for the inferior longitudinal sinus when it exists.

Regions of the occipital bone. These are three in number:—the *occipital* (you may call it *the polar* region if you please;) the *basilary;* the *cerebral;* and the *region of the cerebellum.*

In the *occipital* or *region of the pole* behind the foramen magnum are to be found the tubercle, superior transverse ridge, inferior transverse ridge, external perpendicular spine, fossæ complexi, fossæ splenii, fossæ obliqui, fossæ recti capitis postici majores, fossæ recti cap. antici min., and fossæ recti lateralis, foramen magnum, and posterior condyloid foramina.

In the basilary region are to be found the basilary process, anterior condyloid foramina, lateral processes, fossæ for the four anterior recti capitis and symphisis.

In the *cerebral:*—the fossæ cerebri and superior and lateral limbs of the internal crucial spine; sulcus longitudinalis; and sulci laterales.

In the *region of the cerebellum:*—observe the fossæ cerebelli; the inferior limb of the internal crucial spine; the sulcus occipitalis; the sulci upon the lateral processes; the foramen magnum; the fossa basilaris: and the sulci basilares vel petrosi inferiores.

Fœtal state. There are four centres of ossifi-

cation, one to the most prominent part of the back of the bone (called I believe by phrenologists the indication of *philo-progenitiveness*), one to each condyle, and one to the basilary process. There are consequently intermediate cartilaginous connections; these are indicated by the transverse ridge and external spine, and the thin part of the basilary process at the anterior extremities of the two condyles.

Connections. Its upper crescentic margin is connected to the posterior edges of the two parietals by the *lambdoidal* suture; its lateral and inferior edges to the mastoidal processes of the two temporals by the *additamentum suturæ lambdoidalis.*

Its basilary process is connected by *syndesmosis* to the sphœnoid bone before puberty, and by *synostosis* or union of substance after that period.

Its condyloid processes are received into the first bone of the vertebral column forming a *ginglemoid joint.*

General observations. Although the foramen magnum is not at the centre of the base of the skull, yet it is at its most depending part. Observe also that the longitudinal sulcus is completed by this bone: this sulcus is formed by the frontal, two parietal, and the occipital bones. The lateral sulci are also completed by this bone being common to this and the temporal; the extremities of the lateral sinuses sulcate the lateral processes.

The inferior petrosal sinuses also sulcate the sides of the basilary process as they wind around the edges of the petrosal portions of the temporal

bone, to open into the lateral sinuses as they are on the lateral processes of the occipital bone. The tubercle of this bone is variously elevated in different subjects, it forms a prominent bump on the back of the head, and is a solid process to which is attached the ligamentum nuchæ. The most considerable part of the skull is before the joint of the head, so that the head must fall forwards were it not for the constant and powerful action of the muscles pitting the posterior part of this bone.

OS TEMPORALE.

Situation. There are two of them in number. This bone occupies the lateral and inferior part of the side of the skull and a considerable share of the base.

Shape. Irregular; being divided into a perpendicular smooth portion called the *squamous*, which constitutes the lowest part of the side of the calvarium; and into a transverse thick angular portion called the *petrous* from its hardness and resemblance to a stone, which forms a portion of the base of the skull.

Processes, ten; eight *situated externally:*—

The *squamous portion.*

The *petrous portion.*

The *zygomatic process*, which stretches forwards to constitute the posterior part of the jugal arch; it gives origin to the masseter and zygomaticus major muscles, and attachment to the fascia temporalis.

The jugum is seldom broken, nevertheless a

blow on the part may cause this accident; the parts are kept in apposition by the temporal muscle and jaw-bone behind or within, the fascia temporalis above, the masseter below, and a bandage without.

The *mastoid process*, a thick portion of bone forming a prominent elevation behind the ear, situated at the root of the petrous portion, and at its junction with the squamous; it is hollow, being filled with cells lined by membrane and containing air. On its inner side is inserted the sterno-cleido-mastoideus.

The *eminentia articularis*, the oval root of the zygomatic arch, is lined by articular cartilage, and forms part of the joint of the lower jaw, whereon the condyloid process of that bone is projected in extension of the mouth.

The *styloid process*. This is a spicula of bone jutting downwards and forwards into the upper part of the neck. It gives attachment to the stylo-hyoid ligament, stylo-hyoideus, stylo-pharyngeus, and stylo-glossus muscles.

The *vaginal process* is a ridge of bone sheathing the root of the styloid; its anterior flat surface is occupied by the parotid gland.

The *external auditory process* is a ridge of irregular bone whereon is riveted the cartilage of the external ear.

Two *processes situated internally*:—

The *p. semicirculares*, an elevation of bone seen on the upper part of the petrous portion, indicative of the position of the superior semicircular canal.

The *linea petrosa* divides the cranial aspect of the petrous portion into two surfaces; it gives attachment to the tentorium.

FORAMINA; *four proper.* Two *situated externally:*—

F. auditivum externum or *meatus auditorius externus.* The external entrance to the organ of hearing; it is lined by mucous membrane, is continuous with the cartilage of the ear, and leads to the tympanum.

F. stylo-mastoideum, situated at the roots of the styloid and mastoid processes; it is the opening of the falopian aqueduct, and gives egress to the portio dura of the seventh pair and vidian twig of the par trigeminum.

Two *proper foramina situated internally:*— *Foramen auditivum internum*, or *meatus auditorius internus.* The internal entrance to the organ of hearing, transmitting the seventh pair and internal auditory artery; it terminates in two depressions or fossæ pierced with minute foraminulæ, the larger is the commencement of the internal ear which receives the portio mollis and its artery; and the smaller is the commencement of the aqueductus falopii which receives the portio dura.

F. innominatum is situated on the anterior part of the petrous portion, and carries inward the vidian twig of the par tregiminum to the aqueductus falopii or stylo-mastoid canal.

CANALS, *three:*—

Canalis eustachianus commences at the root of the vaginal process and stretches upwards backwards

and outwards, into the anterior part of the tympanum or enlarged cavity of the external auditory foramen. It is continuous with the *tuba eustachiana* and is lined with mucous membrane.

Canalis caroticus is seen to commence on the inner and posterior part of the root of the vaginal process, and to course inwards and forwards, hollowing thereby the apex of the petrous portion, and to open in the cavity of the cranium by the anterior edge of the extremity of the petrous portion on the side of the base of the skull. It transmits the internal carotid artery and communicating branch of the sympathetic maximus.

Aqueductus falopii commences at some of the foraminulæ in the anterior or lesser fossæ formed in the termination of the meatus auditorius internus; it passes upwards and outwards over the cavitas tympani and receives the foramen innominatum; then downwards and backwards behind the cavitas tympani and opens at the foramen stylomastoideum. It carries the portio dura of the seventh pair and vidian twig of the third pair.

Three *common foramina:—*

Foramen mastoideum posticum.

F. lacerum posticum in basi cranii; between the temporal and occipital bones where they have been already described.

Foramen lacerum anticum in basi cranii. Between the temporal and sphenoid bone, altogether filled with cartilage with the exception of a small foramen for the vidian twig to get into the cranium. Upon this cartilage the internal carotid artery takes its place.

Four FOSSÆ; three externally, one internally.

Fossa temporalis. Giving origin to part of that muscle and occupying the external surface of the squamous portion.

Fossa jugularis. A thimble-shaped cavity situated behind the vaginal process and in the foramen lacerum posticum; it receives the diverticulum of the internal jugular vein.

Fossa cerebralis. The inner concavity at large.

Fossa parotidea. The anterior concave surface of the vaginal process. It gives lodgement to the parotid gland.

Four SULCI;—two externally:—

S. digastricus is situated immediately internally to the mastoid process and gives origin to the digastricus muscle.

Sulcus arteriosus. A groove immediately internally to the last, made by the occipital artery.

Two internally:—

Sulcus lateralis. Sulcating and descending perpendicularly along the inner surface of the mastoidal process; it lodges the great lateral sinus.

Sulcus petrosus runs along under the linea petrosa; it is in the root of the tentorium and lodges the superior petrosal sinus.

PECULIAR PARTS. *Internal organ of hearing*, constituted by the tympanum and its ossicula audita, vestibulum, semicircular canals and cochlea occupying the interior of the petrous portion.

Cellulæ mastoideæ. Lined by mucous membrane, and continuous with the posterior and superior part of the cavitas tympani, occupying the interior of the mastoid process.

Sinus articularis or glenoid cavity for the socket of the lower jaw.

Fissura glasseri. Seen separating the sinus articularis from the fossa parotidea. Through this fissure pass the chorda tympani from the tympanum, and into it the musculus mallei externus.

Aqueductus cochleæ Belong to the internal
Aqueductus vestibuli ear.

REGIONS OF THE TEMPORAL BONE. These are four in number, viz. the temporal, the external petrosal or basilary, the internal anterior petrosal or cerebral, and the internal posterior petrosal or region of the cerebellum.

In the TEMPORAL REGION are found the squamous mastoid zygomatic and auditory processes, the fossa temporalis, and the foramen auditivum externum.

In the EXTERNAL PETROSAL OR BASILARY, at the base of the skull, the sinus and eminentia articularis, the vaginal process, the styloid process, the fossæ parotidea and jugularis; the foramen stylo-mastoideum, the canales caroticus et custachianus; the sulci, digastricus et arterosus; and the fissura glasseri.

In the INTERNAL ANTERIOR PETROSAL OR CEREBRAL; the internal surface of the squamous and anterior surface of the petrous portions forming the fossa cerebralis, the semilunar process, the foramen innominatum and opening of the canalis caroticus.

In the INTERNAL POSTERIOR PETROSAL OR REGION OF THE CEREBELLUM; the fossa cerebelli, linea

petrosa, foramen auditivum internum, itineres ad vestibulum et cochleum, and sulcus cerebralis vel sinus lateralis.

Within the substance of the bone; the INTERNAL ORGAN OF HEARING, consisting of the tympanum, cochlea, vestibulum and semicircular canals, four ossicula audita, openings of the canalis eustactuanus and mastoid cells, and the aqueductus falopii.

FŒTAL STATE. In the fœtus the squamous and petrous portions are separated; the fissura glasseri points out the place of separation. The meatus auditorius is not developed, a ring of bone only existing attached to the squamous portion and having implanted on it the membrana tympani. The mastoid cells do not exist, scarcely the process itself. The zygoma is imperfect—the styloid process is cartilaginous.

CONNECTIONS. The whole of the anterior margin of the squamous and petrous portions is connected to the *posterior edge* of the alæ major of the sphœnoid bone by the *sphœnoidal suture.*

The whole of the upper edge of the mastoid and petrous portions is connected to the anterior edge of the occipital by the *additamentum suturæ lambdoidalis.*

The whole of the upper edge of the squamous and mastoid portions is connected to the under edge of the parietal bone by the *squamous suture.* Observe that the squamous portion overlaps the semilunar notch of the parietal, but that the mastoidal angle of the latter bone is riveted upon the mastoid process.

The zygomatic process is fixed upon the malar bone by the *zygomatic suture.*

The glenoid cavity is opposed to the head of the jaw bone; there is an interarticular cartilage intervening, which renders it a double ginglemoid joint; lateral motion is also allowed.

Observations. It must be observed how important it is to know the situation of the vaginal process, inasmuch as the description of the canals and fossæ situated at the base of the petrous portion cannot be described accurately without mention of it being made; in fine, it may be described as stretching from the root of the mastoid process forwards and inwards in the same line of direction as the petrous portion at large, having *before* it the fossa parotidea, and *behind* it the styloid process fossa jugularis and commencement of the carotid canal. The petrous portion often sustains a fracture when the arched calvarium transmits the influence of the blow or fall. For fracture of the base of the skull there is no remedy, not even perhaps vigorous antiphlogistic treatment, although it is always indicated. If extravasation of blood takes place, no trephine can approach to render relief, the patient seldom if ever recovers by absorption of the extravasated blood, but speedily goes the "way of all flesh living."

An intimate acquaintance with this bone is absolutely necessary in acquiring a knowledge of the relative position of the organs behind the ramus of the lower jaw, and in the substance of the parotid gland.

OS SPHŒNOIDALE.

Situated in the centre of the base of the skull, forming parts of the cerebral cavity the orbits the temples and the nose.

Shape. Resembled to a bat, being possessed of alar projections and a body.

Divided into the two ALÆ MINORES, two ALÆ MAJORES, and the BODY.

Twenty-four PROCESSES. Six processes of the ALÆ MINORES.

The alæ minores are situated on the cranial aspect of the bone, and constitute the most anterior part of it.

Two *anterior ephippial or clinoid processes*, these are two papillary processes, situated laterally to each other by the lateral and anterior part of the sella turcica a cavity easily distinguishable on the upper part of the body of the bone. To these are attached the sphœnoidal folds of the dura mater, and they form a tentorium over part of the internal carotid arteries.

Two *transverse spinous* processes. The sharp angles of bone, which constitute the major part of the alæ minores; they are so situated as to lengthen the surface for the lodgement of the anterior lobes of the brain, being on a line with the orbitar processes of the frontal bone.

One *olivary process.* An irregular elevation between the two anterior clinoid processes; on this decussate the optic nerves before they pass out of the skull.

One *ethmoid.* An angular projection jutting for-

wards immediately before the olivary in the median-line of the scull: this is inserted into the cibriform plate of the ethmoid bone.

Eight processes of the ALÆ MAJORES.

The alæ majores are situated at the side of the base of the skull, and constitute the more expanded parts of the bone.

Two *temporal* processes. These are angular portions of the bone, which form its highest part by jutting up into the temporal fossæ.

Two *orbitar*, somewhat quadrangular in form. These constitute the major part of the outer sides of the orbits.

Two *spinous*. Angular portions stretching backwards somewhat horizontally, and forming a part of the base of the skull.

Two *styloid*. Points or ridges of bone curving downwards toward the pharynx from the apices of the spinous processes. They give origin to the circumflexus palati and musculus mallei externus.

Ten processes of the BODY.

The *body* forms the centre of the bone and also of the case of the skull.

Three situated internally :—

Two *posterior ephippial or clinoid*. These are seen in the skull opposed to the two anterior clinoid. To these are attached the sphœnoidal fold of the dura mater.

One *basilary process*. That thick central process of bone which is usually one in substance with the basilary process of the occipital bone; on it lie the pons varolii the basilary artery and the upper

parts of the inferior petrosal sinuses, beside several of the nerves which course out from their origins to the foramina in the base of the skull.

Seven processes situated externally :—

Two *pterygoidei externi*
Two *pterygoidei interni*

These processes arise at one common root from the under side of the bone.

The *external* stretch downwards, outwards, and backwards, are the widest, and give origin to the pterygoidei externi muscles.

The *internal* stretch directly downwards so as to have plain surfaces internally which are continuous with the cavity of the nose, and are lined by schneiderian membrane, while their outer surfaces give origin to the pterygoidei interni muscles.

Two *hamilar* or hook-shaped processes, which may be considered as representing the talons of the feet; they curve outwards from the extremities of the internal pterygoid processes, and form trochleæ for the tendons of the circumflexi palati.

One *azygous process*. This is a pointed angular-shaped projection from the anterior and inferior part of the body of the bone, between the roots of the internal pterygoid processes, and concealed by its insertion into the vomer. It is hollow, and serves also to give greater extent to the sinus within the body of the bone.

Foramina, twelve *proper* ;—

Two *foramina optica*. These are situated internally and beneath the anterior clinoid processes, (their inner edges constituting them foramina.)

They transmit to the orbits the two optic nerves and opthalmic nerves.

Two *f. lacera orbitalia postica.* These are situated at the backmost part of the orbits, and are formed beneath the alæ minores, and internally and posteriorly to the orbital processes of the alæ majores: they are irregular in their shape, and carry into the orbit the third pair or motores oculi, the fourth or pathetici, the first branch or ophthalmic division of the fifth pair or trigemini, and the sixth pair or n. abducentes, whilst they remit the recurrent ophthalmic veins from the orbit into the cavernous sinuses.

Two *f. rotunda.* These are nearly round in their bore, and direct in their course; commencing a third of an inch below the innermost extremity of the last-described foramen, they pass directly forwards through the substance of the bone, and open behind the tuberous processes of the superior maxillary bones: each transmits the superior maxillary or second branch of the fifth pair of nerves, which on its egress from this foramen, and behind the tuberose process before-mentioned, forms the ganglion of Meckel, whence branches spread widely to the nose palate orbits and temples.

Two *foramina ovalia.* These are situated posteriorly to the last, and nearer the extremity of the spinous processes; they are large and transmit the third or inferior maxillary branches of the fifth pair to parts between the base of the skull and lower jaw, and give ingress to the small inferior meningeal ramifications from the internal maxillary branches of the external carotid arteries.

Two *f. spinalia.* These are found in the very extremities of the spinous processes at the roots of the styloid; they admit to the cranium the middle or spinous artery of the dura mater from the internal maxillary branches of the external carotids. These are the largest arteries of the dura mater, and are the same as were described as occupying the canales spinosi of the parietal bones.

Two *f. pterygoidea.* These are found piercing the roots of the pterygoid processes in a direction from the nasal cavities outwards and backwards towards the apices of the petrous portions of the temporal bones; each is occupied by the vidian twig of the second branch of the fifth pair of nerves, which enters into the cranium from the termination of this foramen, through the foramen lacerum anticum in basi cranii, and then comes through the forum innominatum to get to the aqueductus falopii, in the substance of the temporal bone.

Eight common formina :—

Two *foramina lacera orbitalia antica.* These are situated at the outer and inferior part of the orbit; (called also sphœno-maxillary fissures and for. lacera orbit. infer.) Each foramen gives transmission to the inferior lachrymal twig of the second branch of the fifth pair and a small lachrymal artery from the internal maxillary, while the principal part of the fissure is filled with fat.

Two *f. sphœno-palatina.* These are situated between the upper part of the palatine bone and the anterior and inferior part of the body of the sphœnoid bone. They may be seen through the

lower part of the spheno-maxillary fissure looking behind the tuberose process of the superior maxillary bone. This foramen is of an oval form, and gives transmission into the nares to the lateral nasal branch and the vidian twig of the second branch of the fifth pair of nerves, with the lateral nasal artery of the internal maxillary.

Two *f. pterygo-palatina.* These open upon the backmost part of the palate, and, by thrusting up a bristle, you perceive it to open in the lowermost part of the sphœno-maxillary fissure, or that is to say, directly against the anterior opening of the foramen rotundum of this bone; (so that you see the course which the pterygo-palatine branch takes after coming off from the ganglion of MECKEL, descending through this foramen with its corresponding artery from the internal maxillary branch of the external carotid, both which ramify on the palate.)

Two *f. lacera antica in basi cranii.* Already described with the temporal bone; they are filled with cartilage on which lie the internal carotids; the vidian twig gets into the cranium through a small hole not filled up with that substance.

Fossæ; three pair:—

Two *fossæ temporales.* Hollowing out, slightly, the temporal processes. These form parts of the great temporal fossæ for the lodgement of the temporal muscles.

Two *fossæ cerebrales.* These occupy the whole of the *inner* surfaces of the alæ majores and form

parts of the middle cerebral cavities for the lodgement of the middle lobes of the brain.

Two *fossæ pterygoideæ.* These are formed between the pterygoid processes and give *origin* to the pterygoidei interni muscles.

Sulci; three pair :—

Two *sulci temporales;* these generally exist very evidently on the temporal processes; they indicate the course of the profound temporal nerves and arteries.

Two *sulci cerebrales;* these are depressions situated by the side of the sella turcica; they are made by the internal carotid arteries which sulcate the bone beneath the sphœnoidal folds of the dura mater, as they stretch over them like a tentorium between the four clinoid processes.

Two *sulci eustachiani.* These are seen in the connected skull to furrow the edges of the spinous processes in a direction towards the eustachian canals of the temporal bones; they lodge those parts of the eustachian tubes which are not osseous.

Four peculiar parts :—

Sella turcica. This is a deep depression on the cranial aspect of the body of the bone, *bounded* anteriorly by the olivary and two anterior ephippial or clinoid processes, and laterally by the two sulci cerebrales. In the recent subject it contains the pituitary gland, which is covered in partially by the sphœnoidal folds of the dura mater, and bounded laterally by the two internal carotid arteries.

Sinus sphœnoidalis. This hollows out the anterior

part of the *body* of the bone; is lined by the common membrane of the nose, with which organ it communicates, forms an appendage to the voice, and contains air. (See description of the nose.) It is *bounded* superiorly by the olivary process and sella turcica; inferiorly by the azygos process; anteriorly by the nasal cavity and body of the ethmoid bone; and posteriorly by the basilary process.

Hyatus palatinus. This is an angular space between the external and internal pterygoid processes filled up in the connected skull by the palatine bone.

The *ossa triangularia* are angular cornuated bones seen in the nose to complete the anterior part of the sphœnoidal sinus; they do not exist separately in all, and are not worthy of much mention.

Fœtal state. In the fœtus the alæ majores are connected to the body by cartilage. There are no sphœnoidal sinuses. The azygos process is solid, otherwise the bone may be described as perfect.

Regions. These are the *cerebral*, *basilary*, *orbitar*, *nasal*, and *temporal*.

In the *cerebral region* see the alæ minores with its six processes: the alæ majores with its temporal and spinous only; and the body with the posterior ephippial and basilary processes; the foramina optica, lacera, rotunda, ovalia, and spinalia. See also the fossæ cerebrales, the sinus cerebrales, (for the internal carotids by the side of the upper part of the body) and the sella turcica.

In *the basilary* see the four pterygoid and hamilar processes; the styloid processes of the alæ majores and the basilary of the body: and see also the openings of the foramina ovalia and spinalia.

In the *orbital regions* see the orbital processes of the alæ majores, the anterior surface of the alæ minores, and the openings of the foramina optica and lacera orbitalia.

In the *nasal* see the ossa triquetra, the azygos process, the openings of the sphœnoidal sinus, and the pterygoid foramina.

In the *temporal* see the temporal processes of the alæ majores, the fossæ temporales, and the sulci temporales.

Connections. In the first place, look internally and see the alæ minores at their anterior edge connected to the posterior edges of the orbital processes of the frontal bone and cribriform plate of the ethmoid bone by the transverse facial suture.

In the temples;—The upper edge of the temporal process is attached to the under edge of the spinous process of the parietal bone by the sphœnoidal suture; and by the same suture the whole of the posterior edge of the ala major is connected to the anterior edge of the squamous portion of the temporal bone.

In the orbit;—The orbitar process is connected superiorly to the orbitar process of the frontal bone; inferiorly it is unconnected, the sphœnomaxillary fissure intervening; but anteriorly to the internal orbitar process of the jugal bone.

In the base of the skull;—The pterygoid pro-

cesses receive between them the angular base of the palatine bone. The basilary process is connected to the basilary process of the occipital bone by *synchondrosis* in the young and *synostosis* in the old subject.

In the nose;—The azygos process is received into the groove of the vomer as a nail into a board. *(gomphosis.)* The anterior edge of the internal pterygoid process is seen connected with the posterior edge of the nasal process of the palatine bone.

General observations. This is connected to every other cranial bone. It not only forms the basis of the skull,—the key-stone as it were of the arch of the cranium, but it also contributes very largely to complete the orbits, the parieties and cavities of the nose, the fossæ of the temples, and the boundaries of the fauces,—the fixed osseous margin of the fauces for the origin of their muscles.

On a review of the cavity of the skull you see it resembles a *barrel*,—not altogether an *arch*, as usually described, but a cone, so that in some degree the vibration of a blow performs a circle, and it is only when this circle is interrupted and the impression operates on one given point of this cone, that fracture occurs.

Observe too the wonderful arrangement of the skull in the fœtal state, by which the osseous globe accommodates itself to the circumstances of parturition, the calvarium is loose and the sutures are disconnected, the bones overlap each other and

dispose themselves conveniently to the vagina of the female ; and it is not till after birth, and when the functions of the brain are assuming a vigorous and determined character, that nature walls in permanently a viscus now rising into full exercise of its faculties.

Consequent upon the perfection of the sutures of the skull, nature developes the material organs of sense. The voice leaves the treble notes of childhood for the tenor sounds of manhood ; and for this purpose the sinuses of the frontal, sphœnoid, and maxillary bones are hollowed out, and the before diminutive nostrils are expanded into large and spacious dimensions. Then the final stroke is put to the perfection of the adult cranium by a removal of the cartilaginous and the deposition of an osseous connection between the basilary processe of the sphœnoid and occipital bones ; which does not always occur till a considerable time after puberty.

OS ETHMOIDALE.

This bone is situated at the most anterior part of the base of the skull, superior part of the nose, and innermost parts of the orbit.

Shape, cuboid. It is divided into a BODY, which is cellular ; a SEPTUM, situated perpendicularly between the two halves of the body, which it divides, and SEVEN PROCESSES.

Five PROCESSES of the body :—

P. cribriformis. The *upper* surface of the body, seated in the base of the cranium, formed

by a dense lamina of bone perforated by very numerous foraminulæ.

Two *p. orbitales.* The *lateral* surfaces of the body, binding in the cells with a dense lamina of bone, and forming the inner sides of the orbits, (called also lamella plana.)

Two *p. turbinati sup.* These are scrolls of spongy bone hanging down into the nasal cavities from the *under* surfaces of the body. Their concavities are towards the sides of the nose and their convexities towards the septum. Their use is to make a greater surface for the membrane to be stretched on, in which the olfactory nerves are expanded.

Two processes of the septum :—

One *p. cristatus* or *crista galli.* So called from its resemblance to a cock's comb. It is all that part of the septum above the cribriformis, and consequently jutting into the cavity of the cranium ; it gives attachment to the commencement of the falx major. In front of it is the foramen cœcum.

One *p. nasalis.* All that part of the septum below the body of the bone. It is in fact the septum itself, so nominated for the sake of distinction.

Foramina. *Proper :— Foramina cribrosa.* These are the perforations of the cribriform plate, about twenty in number; through these pass the filaments of the olfactory nerves from the pulpy terminations of the hitherto undivided substances which lie upon the cranial side of the plate. These pass in two divisions into the nose : one supplying

the schneiderian membrane on the septum; the other, the same membrane on the superior turbinated bones.

The *common foramina* are five:—The *foramen cæcum.* Two *f. orbitaria interna antica, et postica.* (For explanation of them see frontal bone.)

Peculiar parts. *Cellulæ ethmoideæ.* These are numerous excavations occupying the body of the bone; the osseous sides of these are thin and dense, but not *spongy*, as often described. They are *bounded* superiorly by the cribriform plate, inferiorly by the turbinated processes, externally by the orbitar processes, and internally by the septum nasi. They are lined with schneiderian membrane and contain air. The anterior cells communicate with the frontal, and the posterior with the sphœnoidal sinuses. There are no muscles attached to this bone.

Fœtal state. In the fœtus this bone is usually described as being perfect; it however has a semi-cartilaginous nasal process, and the cells are not fully developed.

Connections. Its cribriform plate is connected laterally to the inner edge of the orbital processes of the frontal bone; its anterior edge to the root of the internal spine; its posterior edge to the ethmoid process of the sphœnoid bone.

Its orbital process is connected superiorly to the inner edge of the orbitar process of the frontal bone by the transverse facial suture; inferiorly to the inner edge of the orbital process of the

superior maxillary bone by the ethmoid suture; anteriorly to the posterior edge of the lachrymal bone by the lachrymal suture; and posteriorly to the superior orbital process of the palatine bone by the ethmoidal suture.

Its nasal process is connected anteriorly to the nasal process of the frontal bone, and slightly to the two nasal bones; posteriorly and superiorly to the body of the sphœnoid bone; posteriorly and inferiorly to the upper edge of the vomer; and anteriorly and inferiorly to the cartilaginous septum narium.

The back part of the body is easily seen to be in connection with the body of the sphœnoid bone; and some of the anterior cells are bound in laterally by the orbital part of the lachrymal bone.

Observation. This ethmoid is more a facial than a cranial bone, however it ranks among the latter because it forms a part of the anterior cerebral fossæ.

Review of sundry parts seen in the cavity of the cranium.

The anterior cerebral fossæ are formed by the orbitar processes of the frontal bone, the cribriform plate of the ethmoid bone, and the alæ minores of the sphœnoid bone. These lodge the anterior lobes of the brain.

The middle cerebral fossæ are formed by the alæ majores of the sphœnoid bone, the squamous, and the anterior aspect of the petrous portions of the temporal bones. These lodge the middle lobes of the brain.

The POSTERIOR CEREBRAL FOSSÆ hollow out the occipital bone only above the lateral limbs of the crucial spine, as the major portions of the posterior lobes of the brain rest on the tentorium.

The FOSSÆ CEREBELLI are formed by the depressions of that name in the occipital, and the posterior aspect of the petrous and internal surface of the mastoidal portions of the temporal bones.

(The falx major is attached to the crista galli of the ethmoid bone, the internal perpendicular spine of the frontal, the sides of the sulcus longitudinalis of the parietals, and the upper limb of the crucial spine of the occipital bone.

The superior longitudinal sinus is lodged in the sulci longitudinalis of the frontal two parietal and occipital bones, commencing at the foramen cœcum and ending at the junction of the crucial spine.

The lateral sinus engages the lateral limbs of the crucial spine of the occipital, the sulci laterales of the mastoidal angles of the parietals, the sulci cerebrales of the mastoid processes of the temporals, and the upper surfaces of the lateral processes of the occipital.

The internal carotids may be seen occupying the canales carotieæ of the temporal bones, then entering the skull through or *over* the foramina lacera antica; and then coursing along the sulci cerebrales of the sphœnoid bone, by the side of the sella turcica.)

Brief recapitulation of the foramina seen in the skull and their contents.

1. In the anterior cerebral fossæ :—

Foramen cœcum filled with dura mater and a vein.

Numerous foramina cribrosa for the egress of the olfactory nerves and nasal twigs of the fifth pair of nerves.

Two optica, for the optic nerves and ophthalmic arteries.

2. In the middle cerebral fossæ :—

Two f. lacera orbitalia postica, for the egress of the motores occuli, or third pair, patheticæ or fourth pair, ophthalmic branches of the trigemini or fifth pair, and abducentes, or sixth pair; and recurrent ophthalmic veins to enter to the cavernous sinuses in the cranium.

Two f. rotunda, for the egress of the second or superior maxillary branch of the fifth pair, and inferior meningeal arteries.

Two f. spinalia for the ingress of the great or spinal arteries of the dura mater.

Two f. lacera antica in basi cranii, filled with cartilage and pierced by the vidian twig which enters the skull.

Two f. innominata, through which the vidian twig makes its exit.

3. In the fossæ cerebelli :—

Two f. auditiva postica, for the egress of the portiones mollis et dura of the seventh pair, and internal auditory artery.

Two f. lacera postica, b. c. The anterior part gives egress to the par vaga, glosso pharyngeal branches, and nervi spinales accessorii willisi: the posterior to the termination of the lateral sinuses.

Two f. mastoidea postica for veins to the lateral sinuses.

Two f. condyloidea antica for the ninth pair hypo-glossal or motores linguæ.

Two f. condyloidea antica for small veins to the lateral sinuses.

One foramen magnum, for the egress of the medulla spinalis and its membranes, and the anterior spinal arteries; and ingress of the vertebral arteries and nervi spinales accessorii willisi.

SECTION II.

FACIES.

The bones of the face with one exception are all immovable, being fixed points for the origin of muscles not having to perform any locomotive actions, but engaged in the modulations of the voice, the direction of the organs of the senses, and for the purposes of mastication and deglutition. The cavities of the bones of the face are admirably adapted for the support of the visual auditory and olfactory organs, inasmuch as they are elevated upon the top of the skeleton, and are near to the cerebral mass.

They consist of fourteen bones:—six pair, and two single, viz.:—

Ossa jugalia or malarum	Ossa nasalia
— maxillaria super.	— turbinata infer.
— palatina	— vomer
— lachrymalia	Os maxillare inferius

Each os male forms the prominence of the cheek, and constitutes the lateral and superior part of the face.

Shape, irregularly triangular.

Processes. *Zygomatic* process, constituting the anterior third of the jugum or zygoma; on this the zygomatic process of the temporal bone is implanted. The upper edge gives attachment to the fascia temporalis, its lower edge and internal surface to the masseter, and its external or anterior to the zygomaticus major muscle.

One *superior orbital*, which is the highest part of the bone, and is found connected with the external angular process of the frontal bone. This gives attachment to some of the fibres of the orbicularis palpebrarum.

One *inferior orbitar*, so called by way of distinction to the superior. It is the inner angle of the orbital portion, or that part of the bone which immediately articulates with the orbital process of the superior maxillary bone.

One *orbital margin*. The anterior crescentic edge of the orbital portion continuous with the superciliary ridges of the frontal bone.

One *internal orbitar* process. The whole of the orbital process internally to the three last-named processes. Thus some anatomists divide them, but this is only causing unnecessary confusion, the whole portion is but one orbital process.

One *maxillary* process. That triangular rough surface which is implanted upon the maxillary

bone. The anterior surface of this gives origin to the zygomaticus minor muscle.

Foramina. One proper. The *f. malare* enters the bone from the orbital processes, and opens upon the anterior surface of the bone or on the cheek. It gives egress from the orbit to malar twigs of the par trigeminum and small ramifications of the ophthalmic artery, which are distributed to the muscles of the cheek, where they combine respectively with the pes anserinus and inosculate with the vessels of the face.

One common foramen. *F. lacerum orbitale inferius*, which has been already described; it is completed by a slight notch in the orbital process of this bone.

One fossa. *Fossa temporalis.* This includes nearly all the posterior surface of the bone, and constitutes the anterior and inferior part of the great temporal fossa.

Fœtal state. In the fœtus this bone is described as perfect, that is to say, its substance is entirely osseous, but it is developed in its form by the growth and maturity of the subject, so that instead of the round undefined features of the infant in due time we see the pointed and elevated characters of the adult face. This bone gives the prominence to the cheek, and forms one distinguishing feature, by which various tribes of the human race are known and classified.

Connections. Its superior orbitar process is connected to the external angle of the frontal bone by the transverse facial suture.

Its internal orbitar process is connected to the anterior edge of the orbital process of the sphœnoid bone by the sphœnoidal suture.

Its inferior orbitar process is connected slightly to the orbital margin of the superior maxillary bone.

Its maxillary process is implanted upon the rugged jugal process of the superior maxillary bone by the jugo-maxillary suture.

Its zygomatic process is connected to the zygomatic process of the temporal bone by the zygomatic suture.

OS MAXILLARE SUPERIUS.

There are two of them; unitedly they constitute the major part of the skeleton of the face and the whole of the upper jaw.

Processes. One *nasal process*, stretching upwards from the superior part of the bone to constitute a portion of the alæ nasi: it is flat and irregularly quadrangular, having an anterior edge which articulates with the nasal bone; a superior margin which is connected with the frontal bone; an external margin which constitutes part of the orbitar ridge; a posterior margin which is connected with the lachrymal bone in the orbit; and an internal margin or ridge separating the nasa surface of this process into two aspects. Its surfaces are,—an anterior depressed surface, giving origin to the levator labii superioris alæque nasi and part of the levator labii superioris proprius, and insertion to the tendon of the orbicularis palpebrarum; an internal smooth surface, forming

part of the nasal boundary and lined with schneiderian membrane. But as there was described an internal ridge perpendicularly dividing the inner surface into two aspects, it is necessary to describe the posterior as sulcated (sulcus nasalis) and not lined with this membrane, but constituting a part of a canal called canalis nasalis, which transmits the nasal duct from the eye to the nose; and an external smooth surface forming part of the orbit.

One *orbitar process*, situated upon, and in fact constituting the superior smooth surface of the bone; this forms the floor of the orbit, and is encircled anteriorly, in common with the orbitar processes of the jugal and frontal bones, by the orbitar ridge.

One *jugal process*, situated externally, and forming that triangular jagged surface whereon the jugal bone is riveted.

One *alveolar process*, a semicircle of bone constituting the under edge of the maxilla: observe its sponginess which is one distinguishing feature of this process, and its alveolar sockets for the reception of the fangs of the teeth; to this also is attached the gums, a vascular structure covered with the mucous membrane of the mouth, anteriorly the frenum labii superioris a process of the mucous membrane, and just above and by the side of this the depressor labii superioris.

One *palatine process*. This is an arch of bone extending backwards and inwards so as to constitute at once the floor of the nose and roof of the palate; above it is smooth, being lined by the

membrane of SCHNEIDER; below it is rough for the attachment of the soft palate.*

One *spinous process.* This is the inner edge of the palatine process eked upwards in the form of a ridge, which constitutes, together with its fellow of the other bone, a sulcus for the reception of the vomer and cartilaginous septum nasi which are riveted into it.

One *tuberose process.* This is the bulbous posterior part of the bone, against which opens the f. rotundum of the sphœnoid bone, and on which is formed the ganglion of MECKEL, and round which pass the alveolar artery and nerve as they go to supply the molar teeth.

One *transverse ridge*, situated at the root of the nasal process; this is a rough elevation on which hangs part of the inferior turbinated bone.

FORAMINA. One proper:—

Foramen infra-orbitale. This commences under the denomination of the canalis infra-orbitalis, immediately anteriorly to the opening of the foramen rotundum of the sphœnoid bone, in the sphœno-maxillary fissure and above the tuberose process; it runs forwards and downwards immediately below the orbitar process and opens under the orbitar ridge on the anterior surface of the bone. It conveys to the face the infra-orbital artery and nerve from the internal maxillary branch

* Across its under surface the palatine artery and nerve course towards the f. incisivum; and upon its upper or nasal aspect the lateral-nasal artery and nerve are seen taking the same course.

of the external carotid artery and superior maxillary or second division of the fifth pair of nerves which are found to separate into their various branches behind the tuberose process of the superior maxillary bone.

Observe the various situations of the vessels and nerves in connection with this bone on its different aspects. On its *superior* surface you have (encased in a thin lamina of bone) the trunks of the infra-orbital artery and nerve; on its *anterior* surface you see the infra-orbitar artery and nerve inosculating with the facial artery and pes anserinus of the portio dura; on its *external* surface you find the alveolar branch of the internal maxillary artery and alveolar twig of the superior maxillary nerve of the third pair winding their course around the alveolar process above the molar teeth which they supply as well as the deep temporal branches destined to the temporal muscle, and the inferior lachrymal artery and nerve ascending through the sphœno-maxillary fissure to that gland; on the *inferior* aspect or palate we have the pterygo-palatine artery and nerve; on the *internal* or nasal aspect we see the lateral-nasal artery and nerve; and on the *posterior* aspect the ganglion of MECKEL with its radiation of branches, and the *internal* maxillary branch of the external carotid artery.

Three common foramina. *F. incisivum.* This is seen to commence in the form of a single foramen between the two palatine processes of both maxillæ, and immediately in the longitudinal suture of the palate behind the junctions of the two alveo-

lar processes; it then divides into a double canal, each communicating with its respective nasal cavity by the side of the spinous process. Into it pass the terminations of the lateral-nasal and palatine arteries and nerves, each of these inosculate so distinctly as to become continuous in substance.

F. palatinum posticum. Situated between the palatine process of the palatine bone and the inner side of the extremity of the alveolar process of the maxillary bone. It gives transmission to the palate to the pterygo-palatine artery and nerve.

F. sphæno-maxillare or *lacerum orbitale inferius.* This is common to the orbital processes of the sphœnoid maxillary and jugal bones. (See its description under head of sphœnoid bone.)

Canales, three.

Canalis nasalis canales incisivus and *canalis infra orbitalis.* These have been already described.

Fossæ. *Fossa temporalis*, behind the malar or jugal process, forming a part of the great temporal fossa.*

A *fossa* internally and inferiorly to the jugal process on the anterior surface of the bone for the origin of the levator labii superioris.

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* These bones and their parts contribute to form the great temporal fossa, the temporal fossæ of the frontal, parietal, temporal, jugal, and superior maxillary bones: the external angular process of the frontal bone and the zygoma, with the linea temporalis of the frontal, parietal, and mastoidal portion of the temporal bones give attachment to the fascia covering it.

A small *fossa* just above the socket for the lateral incisor tooth, for the origin of the depressor labii superioris.

F. lachrymalis, just above the canalis nasalis on the orbital side of the nasal process. It is like the canal itself, formed partly by this and the lachrymal bone. It lodges the saccus lachrymalis.

Sinus maxillaris or *antrum highmorianum.* This is a sinus of great size occupying the interior of the bone, lined with schneiderian membrane, filled with air, and communicating with the nasal cavity. *Boundaries.* It is bounded superiorly by the orbitar process, inferiorly by the alveolar process, externally by the jugal process, and internally by the cavity of the nose. Its office is the same as that of the frontal and other sinuses. Observe the opening of this sinus is large in the unconnected state, but it is closed partially by the palatine and turbinated bones; the manner of this will be described.

Connections. Its *nasal process* is connected superiorly to the frontal bone by the transverse facial suture;—anteriorly to the nasal bone by the external nasal suture;—posteriorly to the lachrymal bone by the lachrymal suture. Observe lastly, the inferior crescentic edge of the nasal process to which is attached the alar cartilage of the nose.

Its *orbitar process* is connected internally and anteriorly to the orbital process of the ethmoid bone;—internally and posteriorly to the superior orbitar process of the palatine bone.

Its *jugal process* is connected to the malar bone by the jugo-maxillary suture, which also makes a slight external connection on its orbitar surface between the orbital process of the maxilla and inferior orbitar process of the jugal bone.

Its *palatine process* is connected to its fellow by the longitudinal palatine suture; and to the palatine bone by the transverse palatine suture.

Observe *in the nose* the inferior turbinated bone hanging from the transverse ridge and from the antrum of highmore; the nasal process of the palatine bone running up on the inner side of the tuberose process over the back part of the opening of the antrum; and the root of the vomer and cartilago septi nasalis received into the sulcus between the spines of the palatine processes.

In the mouth the insertion of the teeth in the alveolar sockets, by gomphosis connection.

Fœtal state. The substance of the bone is less dense than when matured. The alveolar process contains but six sockets, in which may be seen the teeth enveloped in their capsules; and the antrum of highmore is only commencing to be formed, consequently there exists no tuberosity.

General remarks. The substance of this bone is hard and dense, except that of the alveola, which forms its distinguishing feature. Observe how large a share of the face this bone constitutes, its upper surface forms a part of the orbit; its under, a considerable share of the palate; its inner, a part of the nasal cavity; its anterior, a major part of the face, from which arise most of the muscles of the upper lip.

The opening of the antrum which appears so large in the unconnected bone, is blocked up by the inferior turbinated bone, nasal process of the palate-bone, and schneiderian membrane, which reduce its aperture to the size of a foramen capable of receiving the end of a bougie. Now in *inflammation* of the schneiderian membrane, to which it is very liable, this membrane completely blocks up the opening of the antrum, and if it should extend inwards most distressing series of symptoms supervene, some of the most evident of which arise from the secretion of pus in the cavity which has no vent for its discharge, by reason of which excruciating pain is caused from universal pressure upon inflamed membrane. To relieve this, extract a molar tooth and perforate the thin plate of bone intervening between the socket and the sinus, and after the discharge has been evacuated plug up the aperture and let out the pus as occasion requires, using antiphlogistic measures and even injecting the sinus, if you will, with mild and warm applications until you perfect a cure.

OSSA PALATI.

There are two of these; each of which constitutes a part of the back of the palate, back of the nose, and back of the floor of the orbit.

Shape. It consists of two plates of bone meeting at right angles, one perpendicular the other horizontal.

Processes. *Palatine process.* An horizontal

quadrangular process of bone, constituting the backmost part of the roof of the palate and floor of the nose. Observe its posterior round crescentic margin, which gives attachment to the velum pendulum palati, and the point called by some the azygos process, formed by the union of the palate in the median line, and in the origin of the azygos uvulæ muscle; as well as the continuation of the spinous ridge on the nasal aspect of its inner margin, for the reception of the vomer in the sulcus formed between both these bones in the connected state.

Nasal process. A perpendicular plate of bone ascending from the palatine portion and constituting part of the side of the nose, having a continuation of the transverse ridge on its nasal aspect for the attachment of the inferior turbinated bone; and terminating in two processes termed the superior and inferior orbitar.

Superior orbitar process is seen in the orbit to constitute the extreme point of its floor. It is triangular in shape, and is attached to the body of the sphœnoid bone, and is hollowed in advanced so as to contribute to the formation of the sphœnoidal sinus.

Inferior orbitar process. So called for the sake of description, as it does not constitute any part of the orbit. It is separated from the superior by a semilunar notch, which when completed by the body of the sphænoid bone constitutes the sphœno-palatine foramen. This process is hollow, inasmuch as it contributes to form the parietes of the sphœnoidal sinus.

Pterygoid process. A triangular process of bone fixing its base to the angle of junction between the palatine and nasal portions, and jutting into the hyatus between the two pterygoid processes which it completely fills up. This hyatus has been described in the sphœnoid bone.

Foramina. There are no proper foramina to this bone.

Three common foramina:—*F. palatinum posticum, seu pterygo-palatinum.* This commences in the lowest part of the *sphœno-maxillary fissure*, and continues between the nasal process and the internal pterygoid process of the sphœnoid bone and terminates by opening on the palatine process between that and the alveolar process of the superior maxilla. It transmits the pterygo-palatine artery and nerve, and is common to the sphœnoid and maxillary bones.

Sphœno-maxillary fissure or *f. lacerum orbitale inferius*, already described. It is common to the sphœnoid maxillary jugal and palatine bones.

F. sphœno-palatinum. This is formed by the *semilunar notch* between the orbitar processes and the body of the sphœnoid bone; it may be seen by looking behind the tuberose process of the superior maxillary bone. It gives transmission from behind the last-named process into the nose to the lateral nasal vessels and nerves, and the vidian twig of the par trigeminum.

Fœtal state. In the fœtus this bone is perfect, but the orbitar processes have no sinuses.

Connections. Its palatine process is connected

anteriorly to the palatine process of the superior maxillary bone by the transverse palatine suture; to its fellow by the longitudinal palatine suture; and to the vomer in the same way as the superior maxillary bone, described before.

Its nasal process is connected externally to the superior maxillary bone, internally it receives an attachment from the inferior turbinated bone.

Its superior orbitar process is connected anteriorly to the orbitar process of the superior maxillary bone; internally to the orbitar process of the ethmoid bone; and posteriorly to the body of the sphœnoid bone.

The inferior orbitar process is attached to the body of the sphœnoid bone.

The pterygoid process is fixed between the pterygoid processes (external and internal) of the sphœnoid bone by a gomphosis connection.

General observations. The palatine and pterygoid processes are thick and strong, the nasal and orbitar processes are merely lamellæ. It is of importance to know the situation of this bone, inasmuch as it constitutes parts of the palate, nose, and orbit, and consequently must have reference to the description of these organs, as well as to the arteries and nerves supplying them; and longitudinal sections of the skull will be necessary to see its position with accuracy. This bone is frequently the seat of venereal caries, so that a free communication is made between the nose and mouth, and the food regurgitates into the nostrils when taken in a fluid state.

OS NASALE.

There are two of these. They constitute the upper immovable part of the prominence of the nose.

Shape. Irregularly quadrangular, having four margins.

Superior margin. Thick and ragged, being its narrowest and thickest part; it is attached to the frontal bone by the transverse facial suture.

Inferior margin. Thin, expanded, and sharp; it is next in breadth to the superior, and receives the alar cartilage of the nose to be implanted upon it.

Internal or *anterior margin.* The second in point of length being connected to its fellow by the anterior nasal suture, and behind to the nasal process of the frontal bone and septum nasi of the ethmoid bone.

External or *posterior margin.* This is the longest, and is connected to the nasal process of the superior maxillary bone by the lateral nasal suture.

FORAMEN. F. nasale. On its anterior surface wherein a nerve and blood-vessel are seen to communicate with those of the schneiderian membrane.

These bones are perfect in the fœtus but very small.

GENERAL OBSERVATIONS. These bones from their situation are liable to be broken: their fracture causes great deformity from one portion of bone being depressed. To reduce this fracture pass any small round instrument, such as the end of a female catheter, into the nose and use it as

a lever to restore the depressed portions, at the same time preventing their too great elevation with the index finger of the left hand.

But sometimes this accident is attended with a concussion of the brain, or even a driving upwards of the nasal process and crista galli of the ethmoid bone into the substance of the brain. The most rigorous antiphlogistic treatment is necessary in all fractures of the nose, inasmuch as these bones are neighbours to very important and sensitive organs as the eye brain etc.

OSSA LACHRYMALIA.

There are two of these, each of which is situated on the inner and anterior side of the orbital cavity behind the nasal process of the superior maxillary bone, and upon the anterior part of the body of the ethmoid bone, whose cells it incloses.

Shape. It is a thin plate of bone. Some have resembled it to a human nail, and called it *os unguis*.

Processes. The bone is divided into two surfaces, the *internal* is placed upon the ethmoid cells, the *external* is opposed to the orbit, and is subdivided into two portions by a ridge called *orbitar;* the part of the bone before this ridge is hollow and juts downwards into the nose to become connected with the inferior turbinated bone, in order to complete the canalis nasalis for the nasal or lachrymal duct. This process is termed *nasal*, and the depression is called *fossa lachrymalis*, and is completed by the nasal process

of the maxillary bone already described. The posterior part of the external surface behind the orbitar ridge is termed the *orbitar process.*

Connections. Superiorly with the frontal bone by the transverse suture; anteriorly with the nasal process of the superior maxillary bone; posteriorly with the orbital process of the ethmoid bone; and inferiorly to the orbital process of the superior maxillary bone and nasal process of the inferior turbinated bone.

This bone is perfect in the fœtus.

OSSA SPONGIOSA OR INFERIOR TURBINATED BONES.

These are seen in the nose hanging into the nasal cavities from their sides.

Shape. Its form is triangular, and its appearance spongy, resembling the spongy process of the ethmoid bone.

Its internal surface is convex, and is opposed to the septum nasi, its external concave, and is opposed to the side of the nose.

Processes. The *nasal* or *hamilar process* forms a hook or ledge of bone which fills up that part of the antrum highmorianum below the upper edge of the turbinated bone, or that part which is below a line drawn from the transverse ridge mentioned as raised upon the nasal processes of the superior maxillary and palatine bones, which ridge is for the connection of the upper edge of the inferior turbinated bone.

Lachrymal process, ascending to form an attachment with the nasal process of the lachrymal

bone, and complete the sulcus existing on that process into a canal. (This canal is formed by the lachrymal, superior maxillary, and inferior turbinated bones, and opens below the latter upon or over the floor of the nose.)

This bone is lined with schneiderian membrane and upon it are expended the extremities of the olfactory nerves, by which this bone is made subservient to the organ of smelling.

Its connections have been described.

In the fœtus it is nearly perfect.

Observations. In the adult this bone becomes one in substance with those with which it is connected, and in very old age, it is known to have been almost absorbed.

VOMER.

This is a single bone, situated on the median line of the face, and constituting a considerable share of the septum of the nose, *i. e.* all its posterior and inferior parts.

Shape. It is an irregular triangle, or more properly speaking, quadrangle, one of the angles being of a sufficient length to constitute a margin.

It is usually however described as having three *angles* and three *margins*.

Its *superior* angle is termed the *base*, and is the thickest part of the bone, having a deep angular cavity or furrow, into which the azygos process of the sphœnoid bone is received by a gomphosis connection.

Its *anterior* angle is very acute and prolonged.

Its *posterior* angle is a right angle.

Three margins. Its *superior* margin is its longest and is furrowed, receiving the nasal process of the ethmoid bone and cartilage of the septum into its groove.

Its *inferior* margin is next in length and is not furrowed, but is received into the sulcus between the spinous process of the palatine and maxillary bones.

Its *posterior* margin is crescentic and smooth, being lined by mucous membrane, and is opposed to the fauces.

In the fœtus it is perfect.

Observations. This bone is formed of two laminæ, and is lined by schneiderian membrane, in which the olfactory nerves are expanded.

When this bone is on one side, one nostril is larger than the other. In old men it becomes so thin as to be transparent.

THE NOSE.

Having now learned the parts and connections of the bones of the face implicated in the formation of the nose, direct your attention to its *boundaries*, *septum*, and *meati*.

The nose is that cavity *bounded* superiorly by the brain, laterally by the orbits, inferiorly by the mouth, and posteriorly by the fauces.

It is formed by portions of two bones of the cranium, the ethmoid and sphœnoid, and of all the bones of the face except the two malar and the inferior maxilla; and its offices are found connected

with the sense of smelling, the voice, and the respiratory organs.

The nose is divided into two cavities by a perpendicular septum, and each nasal cavity is subdivided into three chambers or meati, with each of which large sinuosities communicate, situated in the centre of the constituent bones.

SIDE OF THE NOSE. The side of the nose is thus formed; most anteriorly by the nasal bone and alar cartilage, posteriorly by the nasal process of the superior maxillary bone; still more posteriorly by the nasal process of the palatine bone; and most posteriorly by the internal pterygoid process of the sphœnoid bone.

SEPTUM NASALE. The septum nasi is thus formed; superiorly by the nasal process of the ethmoid bone; inferiorly and posteriorly by the vomer; and anteriorly by the cartilago longitudinalis septi.

MEATI NASALES. The meati are three in number—the superior, middle, and inferior.

1. Meatus superior nasi is bounded superiorly by the cribriform plate of the ethmoid bone, and inferiorly by the superior turbinated bone. Into it *open* the posterior ethmoidal cells, the sphœnoidal sinus, and the f. cribrosa of the ethmoid bone.

2. Meatus medius nasi is bounded above by the superior turbinated bone, and below by the inferior turbinated bone. *Opening* into it are,—the anterior ethmoidal cells, the frontal sinus, and the antrum highmorianum.

3. The meatus inferior nasi is bounded

superiorly by the inferior turbinated bone, and inferiorly by the floor of the nose or palatine process of the upper jaw and palate bones. *Opening* into it are, the canalis nasalis conveying the tears from the eye, and the incisory duct (in animals) which is impervious in human subjects in the recent state.

Observations. These bones are all lined by the membrane of Schneider, in which ramify the nerves appropriated to the organ of smelling, these pass in two divisions into the nose, one supplies the septum, the other the turbinated bones; so that the design of the turbinated bones being hung in the cavity of the nose and of the septum, is to increase the surface for the sentient part of the schneiderian membrane.

The design of the sinuses formed in the adult cranium is to give force and tone to the voice, all these being as so many sounding boards, whereby the articulations are rendered sonorous. Where there is an absence of these the person is said to speak through his nose, or more properly to speak *without his nose*, inasmuch as a good development of the nasal cavities is an indispensable accompaniment to a clear and perspicuous voice.

DISEASES OF THE NOSE.

The diseases of the nose are:—

1. Inflammation of the mucous membrane. The treatment is antiphlogistic.

2. Ozœna or altered mucous discharge. Treatment, astringent injections, blisters on the temples, etc.

3. Collections of matter in the sinuses. When in the frontal or sphenoidal nothing can reach the matter, and nature effects her own relief by absorption or ulceration. Use the palliative mode of treatment and study symptoms; when in the antrum, treat it as directed in the description of the maxillary bone.

4. Polypi of two kinds, carcinomatous, and fleshy or common. Treatment of the cancerous; excision or extraction; use of conium and opium topically and constitutionally: caustic lotions when practicable, etc. Treatment of the common; these may also be extracted or will bear the use of stimulants.

5. Cancer of the antrum. No cure. Use palliative measures and subdue untoward symptoms.

6. Hœmorrhage. Epistaxis has been known to prove fatal: if it be sympathetic, attention must be given to the exciting cause: if a local affection only, dossils of lint steeped in solution of zinc, or covered with alum pulverised; a piece of dry sponge drawn into the nose, or introduced upon the point of a probe, has usually succeeded.

7. Venereal ulcerations. The general treatment must be mercurial, with such attention to the peculiarities of the affection as will tend by topical applications to prevent the spread of ulceration.

DESCRIPTION OF THE DIAGRAM OF THE SEPTUM NASI.

A. Os FRONTALE
a. Frontale sinus
b. Nasal process
c. F. cœcum
B. Os SPHŒNOIDALE
d. Sphœnoidal sinus
e. Basilary process
f. Azygous process
C. *Palatine processes* of the SUPERIOR MAXILLARY and PALATINE BONES
g. For. incisivum
D. Os ETHMOIDALE
h. P. cristatus v. crista galli
i. P. cribriformis
k. P. nasalis
E. VOMER
F. CARTILAGO LONGITUDINALIS SEPTI
G. Os NASALE.

OS MAXILLARE INFERIUS.

Situated at the inferior part of the face.

Shape. It is described as resembling the breast bone of a duck or a horse shoe.

Division. The bone is divided into three primary parts. These are the sides and ascending rami.

PROCESSES. *Base*, forming the anterior and inferior part of the bone and boundary of the face.

Alveolar process. Making a semicircle and consisting of bone of a spongy texture with alveolar sockets for sixteen teeth.

Quadruple tubercle (so called from its shape.) Behind the chin or symphisis mentalis, giving origin to the genio-hyoidei and genio hyo-glossi muscles.

Two angles, wherein terminate the base and sides of the bone: their external surface is rough for the insertion of the masseter muscles; their

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nternal surfaces are occupied by the insertion of he pterygoidei interni muscles.

Ascending rami. These form the sides of the ace and are smooth, they are covered by the masseter muscle, their posterior ledge forms the anterior boundary of the cavity for the reception of the parotid gland and cerebral vessels and nerves seen issuing from or entering into the cranium. From the anterior edge of this process the buccinator arises.

Two *processus spinosi.* Peaks of bone situated upon the foramina maxillaria postica. The office of this process is to give attachment to the internal lateral ligament which descends here to protect the vessel and nerve entering the foramen.

Two *coronoid* processes; these are spinous projections from the upper part of the ascending rami, on which are implanted the temporal muscles.

Two *condyloid* processes. These are oblong heads of bone covered with articular cartilage, situated inferiorly and posteriorly to the coronoid, and being each connected to the ascending rami by a *neck.* These form the under parts of the joint between the jaw and temporal bones. Observe the oblique inclination of the two condyles.

Lineæ. *Lineæ mylo-hyoideæ.* Lines easily discoverable extending along on the internal surfaces of the sides of the bone; these give origin to the mylo-hyoidei muscles.

Lineæ semilunares, between the coronoid and condyloid processes, on which are inserted the pterygoidei externi muscles.

FORAMINA. These are necessarily both proper. They consist of two pair and one single.

Two *foramina maxillaria posteriora.* These are seen on the internal surface of the bone, behind two small processes called *spinous*, peaks of bone on each of which a ligament is expanded, to protect the inferior maxillary artery and nerve, (here entering the foramen) from the action of the muscles inserted around these organs.

Two *f. maxillaria anteriora.* These are smaller than the last described, and give egress to the mental arteries and nerves, the diminished continuations of the inferior maxillary vessels and nerves.

One *foramen cæcum.* Formed between the quadruple tubercle and symphisis menti, giving attachment to the frænum linguæ.

CANALES. Two *canales mentales.* These run in the substance of the bone like gas-pipes in the streets, between the posterior and anterior maxillary foramina, and carry forward the inferior maxillary arteries and nerves, processes from which ascend into the fangs of the teeth, through smaller canals communicating with the alveolar sockets.

One *canalis mentalis anterior.* This is but a continuation of the canal between the two anterior maxillary foramina carrying the incisory arteries and nerves to the incisor teeth.

FOSSÆ, four situated externally. Two *fossæ*, for the origin of the levatores labii inferioris below the incisor teeth.

Two *depressions* more general, for the origin of the depressores labii inferioris, and two for the anguli oris.

Two situated internally. Two *fossæ*, well marked under the chin for the insertion of the digastrici. Internally are also attached the genio-hyoidei, mylo-hyoidei, etc. already mentioned.

Sulci. Two *pair*. Two *sulci* for the lodgement of the maxillary arteries and nerves, as they run along the inner side of the ascending rami of the lower jaw, to the posterior maxillary foramina.

Two *sulci mylo-hyoidei*. Formed by the impressions of the mylo-hyoid vessels and nerves, these run from the posterior foramina forwards on the inner surface of the bone.

The alveolar sockets are already described.

Fœtal state. In the fœtus this bone is divided into two halves at the chin, which are connected together by cartilage in the form of the symphisis menti, but this soon ossifies and the bone becomes one in substance. The ascending rami are very oblique and short in the fœtus, but towards puberty they assume a perpendicular position and are fully developed as well as the base and the chin, which give definition to the features of the adult.

Connections. The condyloid processes form part of the joint of the jaw, and permit of free angular and diminished lateral motion.

JOINT OF THE LOWER JAW.

The *articular surfaces* of the joint are the glenoid cavity and eminentia articularis of the temporal bone, the interarticular cartilage, and the condyloid process of the lower jaw.

Ligaments. A *double capsular*, one between the articular surface of the temporal bone and the interarticular cartilage; the other between the latter and the condyle, making this a double joint.

Internal lateral ligament, attached superiorly to the inner margin of the articular sinus of the temporal bone, and inferiorly to the spinous process of the inferior maxilla.

There is no decided external lateral ligament, and notwithstanding which, and the free motion allowed to the bone, dislocation is not a frequent accident.

The interarticular cartilage is doubly concave-convex, being exactly moulded to the form of the sinus and eminentia articularis above, and the head of the jaw below.

Dislocation of the jaw. The jaw can only be dislocated forward, inasmuch as the formation of the joint precludes any other. One or both condyles may be dislocated at once; in either case the nature of the accident is so perceptible that no description of the symptoms is necessary.

To reduce it, sheath well both your thumbs with some leather or wadding and thrust them into the mouth as far back as possible and place them on the inner side of the dislocated condyles, your fingers will then rest upon their outer side and the bone will be grasped between them and your thumbs; first depress the condyles and then slide them backwards over the articular eminences of the temporal bone into their sockets, and take care of your thumbs at the same time. If it be a single dislocation, the process is the same.

FRACTURE OF THE LOWER JAW. This is so evident an accident that the symptoms need no description. *Treatment.* Reduce the fracture and place the broken parts in apposition and keep them so by wetting pasteboard and moulding it to the shape of the jaw, letting it gradually dry; this makes a convenient and appropriate splint; (or a thick compress of linen or any thing else of that kind, kept firmly against the lower jaw by a bandage;) use a roll bandage to be brought over the head, with a pouch to contain the lower jaw; apply cold lotions, and if necessary, abstract blood. The patient must be put on spoon diet.

DENTES.

These are situated in the mouth, fixed in the alveolar sockets of the upper and lower jaws, and are thirty-two in number, *i. e.* sixteen to each jaw.

In shape, they are wedge-like, being divided into a *base* or *body*, which hangs into the mouth and is composed of dense osseous substance encased in a white shining porcelain-like substance, termed *enamel;* and into one or more *roots* or *fangs* which are prolongations of the body, tapering in form, sulcated on either side, flattened so as to be the better riveted in the alveolar sockets, and whose covering is similar to the periosteum of other bones.

The *cervix* is that narrow line which is the point of connection between the body and the fang.

Foramen dentale seen in the point of each fang,

and forming the commencement of a passage leading into a *sinus*, the internal common cavity wherein is confined the central pulp, a vascular and nervous structure.

The teeth are divided into three classes, viz. four *incisores*, two *cuspidati*, four *bicuspidati*, and six *molares* in each jaw.

Situation of the various kinds. The four incisor range in front, the canine or cuspid tooth comes next on either side, then two bicuspid more posteriorly, and most posteriorly three molar or grinding teeth on either side of the jaw.

Peculiarities of the three classes.

Incisores, have their bodies as if pinched, thereby making two surfaces and an under straight sharp ridge; the anterior surface is convex and smooth, the posterior surface is concave and fluted; a single fang.

Cuspidati, have their bodies in the form of a wedge of a triangular shape, a rounded inferior edge, and a ridge on its posterior surface; its fang, which is single, is generally the largest.

Bicuspidati, have a cuboid body, pointed below in two places, giving the appearance of a small part of its substance having been scooped out so as to leave two pointed projections before and behind. The external point is the largest in the upper jaw, in the lower they are equal; a single fluted fang.

Molares of the lower jaw. On their bodies at their under part, the first molares have *five*, and the other posterior, *four* points: each molar tooth has from two to four roots or fangs.

Molares of the upper jaw. On their bodies at their under sides each first molar tooth has *four*, and the others only *three points;* and generally each upper molar has one fang more than the lower. The last molar tooth has a less number of roots.

Connections. The teeth by means of their fangs, have a *gomphosis* connection with the alveolar sockets, they are also kept in by a process of the gum which is inflected over the surface of each alveolar socket, and becomes its periosteum as well as a kind of capsule to the fang itself.

Fœtal state. As was before stated, there are only *six* alveolar sockets in the fœtal jaw. These are large and contain the bases or bodies of five teeth termed *deciduous*, from their being shed after a short period of use, and of the anterior molar which is a permanent tooth. These teeth are contained in *capsules* which are connected with the parts around by an artery and nerve. They have no root.

As the teeth are more particularly the subject of an art termed dentistry, it belongs more to its practitioners than to anatomists, wherefore to their treatises I shall refer those for further information who are curious in this matter.

os hyoides.

Situation. In the anterior and upper part of the neck below the position of the lower jaw, and at the root of the tongue.

Its shape is crescentic like the letter *v*. It is divided into a *body* and *two cornua*.

Parts of the body. The body is the most anterior part of the bone, and has its convexity forwards and concavity backwards. On its anterior convex surface are depressions for the insertion of the sterno-hyoidei, omo-hyoidei, and thyreo-hyoidei muscles. Several depressions also exist on its superior part for the insertion of the genio-hyoidei and genio-hyo-glossi. Its posterior concave surface is smooth, and lined with the mucous membrane of the throat; and its inferior surface gives attachment to the ligamentum thyreo-hyoideum.

Parts of the cornua. The broadest parts of the cornua are opposed to the extremities of the body; between these there is a cartilaginous connection in the youth, which becomes osseous in more advanced periods of life. Upon this *symphisis* there is a process of bone, at first connected to it by a regular joint and capsular ligament, but which also in course of time becomes converted into a fixed osseous connection. This process is termed the *graniform appendage*, from its resemblance to a barley-corn, and on it are affixed the inferior parts of the two ligamenta stylo-hyoidea. As the cornua extend backwards they taper, and finally terminate in tuberculated points. They give attachment to the tendinous angles of the digastrici, the stylo-hyoidei, and the mylo-hyoidei, and origin to the hyo-glossi, constrictores medii pharyngis, and linguales muscles.

Fœtal state. The base cornua and graniform appendices are all cartilaginous in the fœtus, soon however a nucleus of bone is deposited in their

various centers, and the process of ossification is not completed till in matured life all these parts become united in substance.

Connections. No other connections than the *styloid ligaments* attach this to any bone. These stretch from the styloid processes of the temporal bones downwards and forwards, and are implanted upon the graniform appendices of the os hyoides.

As to the other ligaments of this bone which belong to the description of the larynx I must refer the inquirer to that subject.

CHAPTER III.

BONES OF THE TRUNK.

These are divided into three classes, which are denominated the SPINE, PELVIS, and THORAX, all of which are comprised within those portions of the human frame denominated the neck and body.

SECTION I. THE SPINE.

This is a column of bones, continued down the posterior part of the back, the designs of which are as follow.

1st. To support the head; for which purpose we find it is connected superiorly with the base of the skull.

2nd. To keep the trunk erect, hence it performs the office of a staff of bone, extending throughout its length.

3rd. To transmit the spinal prolongation of the nervous substance of the brain called medulla spinalis, and to give it protection; hence we have it hollow throughout, forming a canal in its centre.

4th. To give a general power of motion to the trunk; hence we have the column divided into twenty-four parts, each part having limited motion between it and its fellow, and permitting therefore very extensive aggregate motive capabilities.

5th. To give support and protection to soft structures and those viscera the organic functions of which are necessary to life; hence we have these bones forming parts of cavities and pillars of support.

6th. To transmit the weight of the body to the extremities or bones below; hence the inferior part of the column is connected with the pelvis upon which as upon an arch it throws its weight.

7th. To give origin to muscles. 1st. For the support of the trunk and of the column itself; hence we have the column throwing out processes behind. 2nd. For the support of viscera and motion of the chest; for which we have the column forming processes at its side.

8th. To interrupt the transmission of a shock from the extremities, in the act of leaping or falling, to the head and thereby prevent concussion; hence the vertebral column is waved and irregular.

The VERTEBRAL COLUMN is classed into two principal divisions called the TRUE and FALSE.

The TRUE are subdivided into THREE SETS OF BONES, viz.

The CERVICAL, or *superior*, consisting of seven.

The DORSAL, or *median*, consisting of twelve; and

The LUMBAR, or *inferior* set, consisting of five.

The FALSE VERTEBRÆ are the SACRUM and OS COCCYGIS. These will be mentioned in the description of the pelvis.

PROCESSES OF A VERTEBRA. A vertebra is composed of a *body*, or *posterior arch*, and seven *processes*:—

Body. Cellular in structure, forming the anterior bulky part of the bone, having an horizontal superior and inferior surface, which are apposed to the under and superior parts of the bones above and below, and on the circumferences of these surfaces a circular dense ring of bone, rendering these surfaces somewhat concave. The anterior surface of the bone is convex; the posterior forms a part of the columnal canal mentioned before, and is therefore concave.

Posterior arch. A ring of bone, forming the posterior part of the canal and the common root to the seven processes; on its upper and under sides may be seen, the

1. Four oblique processes. Two *superior*, which have articular surfaces, forming part of a joint betwixt these and the inferior oblique processes of the bone above; and two *inferior*, which have similar articular surfaces, forming part of a joint with the bone below.

2. Two transverse processes. These are situated on the lateral parts of the posterior arch; their roots being between the four oblique. They give origin to muscles of the back and belly, which shall not be mentioned here, inasmuch as they would only puzzle instead of help the student.

3. One spinous process. This proceeds from the back of the posterior arch, and is devoted to the same purposes as the transverse process, viz. to give origin to muscles, and to limit the extent of motion permitted to be enjoyed between two vertebræ.

FORAMINA. These are all common, being completed by the connected bones; they consist of the following:—

1. SPECUS VERTEBRARUM, formed by the posterior concave surfaces of the bodies and anterior concavities of the arches of the vertebræ, each vertebra constituting its part with the membranes and soft structures to form a canal: this specus contains the medulla spinalis and commencements of the spinal nerves, the spinal arteries, veins, and the ligaments and membranes of the spinal marrow.

2. FORAMINA INTERVERTEBRALIA. These are situated at the side of the spinal column, and each is formed by a furrow seen sulcating the posterior arches of the vertebra above and below. They give egress to the spinal nerves and veins, and ingress to arteries inosculating with the spinal within the canal.

3. FORAMINA VERTEBRALIA. These are peculiar to the cervical, and are formed in the transverse processes of the six superior cervical vertebræ through which the vertebral arteries course towards the cranium and the vertebral veins descend. Observe the seventh vertebral foramen (or that in the seventh vertebra of the neck,) if it exists at all, contains only the vertebral veins.

FŒTAL STATE. In the fœtus the vertebra consists of three parts. The body is imperfectly ossified, and the posterior arch in two parts which are connected to each other by cartilage, where the spinous process should exist; and also to the sides of the body by the same substance. The oblique

processes are perfected, but the transverse are on in process of formation, being little projections cartilage: in consequence of which there is gr latitude of motion in the fœtus, and the body is lowed to be bent forwards to accommodate itself the cavity of the uterus during the period of ute gestation; and inasmuch as it is not necessary the well-being of the new-born child to itself, its transverse and spinous processes h leisure to develope themselves gradually, until mind of the child becomes more perfected it begins to see its necessities, and learn its ca bilities; and when the limbs acquire their cunni and the mind its reflecting powers, then the b strengthens itself to give to the child, now becom a rational creature, its erect and exalted form.

Connections of the column at large. The bo are connected superiorly with the condyloid proc of the cranium, in a *ginglemus joint;* inferio with the sacrum in an arthrodial apposition surfaces; and with each other by the same; a laterally the dorsal vertebræ, have attached them the heads of the ribs. The connections be treated of more largely after the peculiari are discussed.

Peculiarities of the three classes.

CERVICAL VERTEBRÆ.

These have a small *body* of a dense struct and a waved form; thus the under surface of anterior part of the one cervical is pinched as it w into a process which overlaps the upper part of

body of the other, whilst the sides of the upper part of the latter are eked upwards into processes overlapping the under part of the sides of the former. The transverse diameter is found to exceed the antero-posterior in breadth. The transverse processes are short, sulcated above by the cervical nerves as they emerge from the canal, and contain the vertebral foramina. From the anterior surfaces of these processes the longi colli and recti capitis antici majores arise. The oblique processes are very oblique : the superior face upwards and backwards, the inferior downwards and forwards. The spinous processes are short horizontal and bifid, and sulcated below. The *specus* is large and triangular.

Peculiarities of the individual cervical vertebræ.

The first, second, and seventh, mustbe particularly noticed.

The first or ATLAS, so called by the imaginative ancients from its supporting the spherical head, has no body, but is composed of two *arches*. The *anterior arch* has an articulating surface behind for the odontoid process of the v. dentata ; and two tubercles laterally to it for the attachment of a transverse ligament enclosing the same process, and excluding it from the specus. Its transverse processes are very large from which arise the recti capitis minores and laterales muscles. The *posterior arch* is sulcated on its under side by the vertebral veins which turn inward to enter the foramen in the transverse process of the vertebra below, and on its upper surface by the vertebral arteries which take a turn inwards from

the vertebral foramina to enter the skull. These sulci are immediately behind the oblique processes. The superior oblique processes are hollow articular surfaces receiving the condyles of the occipital bone, they are of a semilunar shape, and look upwards and inwards. The inferior oblique processes are rather flat, and look downwards and inwards. Instead of a spinous process there is a tubercle. A tubercle may be observed also anteriorly which points out the site of the body, and forms a point on which is attached the commencement of the perpendicular ligament.

Second, or VERTEBRA DENTATA. This is so named because the upper part of its body is prolonged into a pivot called *processus dentatus*. This has an articular surface upon its anterior part which is opposed to the back of the anterior arch of the atlas. Its transverse processes are small. Its foramina vertebralia are obliquely situated. Its superior oblique processes are mere surfaces on the side of the body, and look upwards and outwards: its inferior oblique processes seem drawn away as though the superincumbent weight of the globe of the head had made the body of this vertebra to yield; its surfaces look downwards and forwards. The specus is sometimes smaller, often larger, and cordiform. The posterior arch is thick; and the spinous process is like the tail of a swallow thick and shelving.

FŒTAL STATE. In the fœtus the dentata consists of four portions, the fourth the odontoid process being an epiphysis or centre of ossification of itself connected by cartilage to the body.

The *seventh vertebra* approaches to the form of the dorsal and seldom contains any vertebral foramina.

DORSAL VERTEBRÆ.

These have their *bodies* larger and less dense than the cervical, an horizontal surface above and below, with a prominent circular edge, a flattened side, and a concave posterior surface. The body also is widest in its antero-posterior direction, distinguishing it thus from the cervical. On the sides of the body are four articular surfaces, each two of which form the half of concavities or articular depressions for the attachment of the ribs: thus the under articular surface of the body of the fifth vertebra, the upper articular surface of the body of the sixth, and the intermediate intervertebral substance, form the articular depression for the head of the fifth rib. The transverse processes are very large and tuberculated, fronting outwards and backwards, and having articular surfaces on their extremities for the angles of the ribs. The specus vertebrarum is small and round. The superior oblique are *perpendicular* processes and look almost directly backwards. The inferior oblique are *perpendicular* surfaces looking forward and a little inward. The spinous process is long and situated very obliquely so as to present a spine on its back; and on its inferior part, a sulcus which overlaps the spine of the vertebra below, impeding by this means much motion between each bone. The articulating surfaces of a dorsal vertebra are twelve: two on the upper and under surfaces of the body, four on the

sides of the body, two on the transverse processes, and four on the oblique process.

Peculiarities of individual vertebræ of the dorsum.

The vertebræ worthy of particular mention are the *first* and the *last two.* The *first* has much resemblance to the last cervical, and contains the whole of the articular depression for the first rib. The last but one, or *eleventh* dorsal, has but a depression on its lower part; and the *twelfth*, in addition to its resemblance to the lumbar, has no articular surfaces at all on its transverse processes.*

LUMBAR VERTEBRÆ. The bodies of the lumbar vertebræ are the largest the most cellular and most circular; the upper and wider surfaces are more concave, and the anterior sides are a little depressed by the action of the aorta abdominalis. Here also observe that the greatest width of the body is in the lateral direction, distinguishing these very essentially from the dorsal. The transverse processes are placed transversely, and are thin and small: the superior oblique processes look inwards and backwards; the inferior look outwards and forwards. The specus is large and triangular. The

* Observe the different sizes of the bodies of the dorsal vertebræ how (as will be particularly mentioned hereafter) they are found to decrease from the first to the third, fourth, or fifth, and then gradually increase to the last. Remark also their pinched form as though some organs had compressed them at their sides, and thereby rendered their antero-posterior diameter the longest. From the third to the last on their left side pulsates the aorta, and on their right side is to be found the ascending vena azygos, whilst before descends the œsophagus.

articulating surfaces are six: two on the body, and four on the oblique processes.

CONNECTIONS AND LIGAMENTS OF THE VERTEBRÆ.

The great medium of connection between the bodies of the vertebræ are the *intervertebral substances.* These consist of a dense interlacing of fibro-ligamentous bands stretching obliquely between the cartilaginous and osseous circles of the bodies of the vertebræ. Within this outer ligamentous girdle a second species of cellulo-ligamentous substance of different degrees of density is arranged as it were concentrically; and the thicker or more ligamentous are the most exterior laminæ; whilst the ligamentous parts of the interiormost laminæ are fewer in number and the space filled with a fluid secretion. Now, the design before mentioned of making the spine a moveable column is thus carried into effect; the nature of the pulpy center of this intervertebral substance is, not to yield to incumbent pressure because it is of a semi-fluid consistency; and the nature of the exterior ligamentous part is, to yield to pressure but not to be affected by extension, it is not extensible but elastic. Thus the circumference of this connecting ligament will permit the two bodies to meet each other and perform lateral or bending motion, whilst the internal unyielding semi-fluid substance will form a fixed point, so that a ball and socket joint is made to exist between the two bones.

We see also stretching downwards from the atlas

to the sacrum the *ligamentum vertebrale anticum commune;* which is a band of ligamentous fibres bracing the anterior parts of the bodies of the vertebræ and their intervertebral substances. But the manner of its formation is thus; not that the same ligamentous fibre which constitutes the upper part of the band should constitute the extremity of it also; no, but certain fibres stretch from the anterior surface of one body over the intervertebral substances and body of a second, and perhaps of a third also, and become implanted on a fourth; and so promiscuously arising and being implanted upon certain bones of the vertebral column, these ligamentous fibres, taken in the aggregate, form the ligamentum vertebrale anticum commune.

In addition to this some have described crucial ligaments; but these are lateral decussations of the same ligament.

In like manner we have also a few slight intersections called for the sake of distinction, *ligamentum vertebrale posticum*, stretching down the posterior concave surfaces of the bodies and intervertebral substances within the specus.

Ligamentous fibres also fill the interstices between the transverse and spinous processes.

Capsular ligaments. To each joint between the oblique processes.

Ligamenta subflava. These are very important ligaments; they fill the interstices between the posterior arches, and are termed subflava from their colour, which resembles a dull yellow. Now, these being opposed to the intervertebrals,

must necessarily, if inelastic, render impossible antero-posterior motion; wherefore they are composed of semi-cartilaginous substance, capable of yielding and of being extended so as to permit very general motion in a bending direction.

Ligaments of the atlas, v. dentata, and os occipitis.

The student must turn to the description of the parts forming these joints and then learn the connections as thus given.—

Capsular ligaments, between the condyloid processes of the os occipitis and the superior oblique processes of the atlas, inclosing a compound ginglemus joint. This admits of flexion and extension only.

Theca circularis. A membranous substance connected superiorly to the circle of the foramen magnum, and inferiorly to the posterior arch and transverse ligament of the atlas.

Ligamenta capsularia, stretching between the oblique processes of the atlas and v. dentata.

Ligamentum transversale. A ligament, thick and strong, stretching across from one tubercle to another within the specus of the atlas, behind the odontoid process, which it prevents from encroaching upon the spinal marrow. When this process of ligamentous substance is broken, the head falls forward, and the odontoid process bearing against the medulla spinalis, almost instant death is the result, unless the head be returned and supported in its right position.

Ligamentum perpendiculare. This stretches

upwards from the odontoid process to the anterior part of the foramen magnum, to a tubercle easily discoverable there. This ligament puts a restraint on too much rotation.

Two *ligamenta lateralia vel moderatores.* These commence from the same spot as the last, and stretch outwards to become attached to the anterior arch of the atlas and to the inner edge of the side of the foramen magnum; they are of great power, and prevent too much rotation.

Appendices ligamentosæ perpendiculares. These are processes of the transverse ligament which stretch from the atlas to the foramen magnum above, and to the vertebra dentata below.

The ligaments between the last vertebra and the sacrum are the same as between individual vertebræ.

General observations. Having then considered the various uses of the bones of the vertebral column, seen them separated, and then joined together, and their various ligaments and bonds of union being demonstrated in situ naturale, let us look at the vertebral column and see how this complicated structure performs the purposes for which it is intended. In the first place it is a pyramid composed of certain minor pyramids, the bases of the two first of which meet each other in the body of the seventh bone of the neck, the second of which ends in the third or fourth bone of the back, and meets the apex of the main pyramid which has its base fixed upon the sacrum; or in other words, the size of the vertebræ increases

from the first to the seventh cervical, then diminishes to the fourth dorsal, and then increases again to the last lumbar. On this great pyramid rests the sphere of the skull; so that its weight is transmitted throughout, and thrown upon, the arch of the pelvis. But an untutored person might prejudge that in order to effect this the spinal column should be *straight;* it is therefore to him a matter of surprise that nature has thrown up a series of arches and made the pile of bones to assume a serpentine arrangement; he therefore proposes the question, why should this form obtain? — These are the reasons. — Firstly, to prevent the transmission of a shock to the brain in the leaping and walking exercises of the limbs, because the influence of a shock must traverse a straight line, and cannot deviate with the flexures of the vertebral column, and consequently the effect is expended upon the abdominal cavity, where are no organs to catch the vibration or suffer from its force. The knotted form also of the individual bones of the column tends to weaken the force of the shock. Secondly, to give space to the cavities, and protection to the viscera. Thirdly, to give more extensive attachment and greater powers to muscles on the back.

Thus you have the cervicals bending forward so as to go considerably before a line supposed to be drawn from the centre of the base of the skull, through to the centre of the cavity of the pelvis, which line is in reality the central line of gravity. Next we have the dorsals curving backward so

as to meet it again, and then proceeding behind it as the cervicals did before it; and subsequently curving forward, once more meeting it at its lower part. Lastly, the lumbar vertebræ so much curving forwards as to throw the line posteriorly to the centre of the connection between the sacrum and the last lumbar vertebra; by which circumstance it is met by the arch of the pelvis, and the weight either transmitted to the tuberosities of the ischium, supporting the body in a sitting position, or to the legs in a standing.

Thus it is easily to be seen how dangerous the too usual practice of leaning forwards among children and growing persons is, who thereby alter the line of gravity, and throw it upon the chest, the consequence of which is, in too many instances, consumption and corporal imbecility, because the free motions of the chest are impeded, and that cone of ribs which should be an exceedingly free and expansive cavity, is made to become an arch of support.

We see the manner in which the cervical vertebræ are thrown forward, by the intervertebral substances being thickest anteriorly; how the dorsal are thrown backwards because the bodies of the vertebræ and their intervertebral substances are thickest posteriorly; and how the lumbar are convex anteriorly by the disparity in the degrees of thickness of the bodies and intervertebral substances in their anterior and posterior parts.

We see too what various latitude of motion is allowed to the three portions of the vertebral

ımn: that in the neck is the pivot of motion the head, in which the visual, auditory, olfac-ɾ, and the gustatory senses are seated; to the exercise of which in man, who is an erect ıg, much motive power is an essential quality. 3ut in the dorsal vertebræ not much motion is wed: the vertebræ having retroverted from central line of gravity to form a cavity for the tection of the thoracic viscera; and also because ribs require a fixed point whereon to move. l the manner in which nature, or rather I should , the Creator, has effected in infinite wisdom his poses, is by making the bodies smaller, and the rvertebral substances thinner, the oblique pro-es more perpendicular, and the spinous to overlap another.

ɛASES, DISLOCATIONS, AND FRACTURES OF THE VERTEBRÆ.

'he most frequent disease of the spine is called VATURE. This disease is sometimes congenital, erally attacks children and growing persons, it;" says Mr. POTT, "I have never seen a person cted with this disease at an age beyond forty." t first the person affected becomes awkward unskilful in the use of his legs, stumbles a great , is languid and listless, is unwilling to move h or briskly, and when he does he crosses his very frequently and involuntarily, causing him ll. During its advance, the inability to make rrect progression is followed by total uselessness he inferior extremity. Pain is now referred to

the back bone, and when examination is made, a curvature is detected. If the curvature be in the back, dyspepsia and indigestion form very unpleasant accompaniments; difficulty of breathing also, and a sense of constriction frequently exist.

The cause of the complaint is a morbid condition of the spine or organs in the neighbourhood: as for instance, where caries of the bone is induced by any exciting cause, the body becoming absorbed, the spine falls in and causes a curvature.

Treatment. The use of any iron apparatus or machines is altogether to be avoided, and issues and the practice of counter-irritation to be sedulously persisted in. Mr. Pott says, "That the useless state of the limbs is by no means a consequence of the altered figure of the spine or of the disposition of the bones with regard to each other, but merely of the caries;" "of this truth there needs no other proof than what may be drawn from the cure of a large and extensive curvature, in which three or more vertebræ were concerned; in this the deformity always remains unaltered and unalterable, notwithstanding the patient recovers both health and limbs."

Spina bifida or hydro-rachitis. This is a congenital disease, consisting of imperfections of the osseous canal at some one part of the vertebral column but generally of the lumbar, and the appearance of a swelling caused by the existence of a fluid resembling serum and capable of coagulation. Sometimes children affected are unable to retain their fœces or urine or even to walk, at other times cases occur without either of these contingences.

This disease is generally fatal. Sir Astley Cooper and others have recorded cases treated with success. The practice was puncture, and then pressure by means of a plate upon the tumor and rollers. (See Med. Chir. Trans. vol. 2.)

Rachitis. This disease affects the spine in common with most other bones. The rickets are chiefly an affection of childhood, seldom occurring in adults. It results from a want of due consistency and strength in the bone, or an absence of the proper proportion of ossific matter, and is often implicated with scrophula; or at all events, if not with that disease, with a bad constitution and a depraved habit of body. The symptoms are too evident to require detail. Tonics, and the constant use of sea bathing where practicable, are indicated.

Fracture. The vertebræ from their shape are not very liable to fracture. The spinous process is the most often affected, but this is a trivial thing of itself, yet the blow or injury sufficient to cause this may produce concussion or some more serious symptoms. These are the only kinds of fracture which admit of detection, others may exist, but their symptoms are so dubious, that all required to be done is to attend to the effects, and to remedy them by the use of rigorous antiphlogistic treatment, rest, purgatives, mercurials, and antispasmodics.

The fracture of the upper cervical, and odontoid process of the second vertebra, are always suddenly fatal.

Dislocations. Dislocations of the vertebral bones cannot exist without fracture of the oblique

process, owing to the limited motion allowed from the elevation of the various articular surfaces and the overlappings of the spinous projections.

Dislocations of the atlas from the second cervical (which occasionally occurs in hanging) causes instant death. Complete dislocations of the lower cervical vertebræ have occurred, or at least so says BOYER.

Partial dislocations of the neck may occur, that is, only of one articular surface, in which instance the mischief is not so serious as to destroy life immediately, unless concussion does it; if, however, no bad symptom supervenes on the accident, by all means do not create them by an attempt to reduce the partial dislocations. But if there be *compression* and danger of the patient losing his life, then you are justified in giving him a chance either of cure or death *secundum artem*, by first running the risk of putting a period to his existence, by inclining the head to the side towards which it is already directed, "with a view to disengage the articulating process of the upper vertebra;" when this is performed apposition of the oblique processes is to be effected by rotation of the head in an opposite direction to the course of the luxation.

SECTION II. PELVIS.

The *pelvis* is that bony cavity which constitutes the inferior part of the trunk. In its right position it forms an *angle* with the other part of the body, being situated obliquely, so that its wide upper part or opening presents upwards and forwards, and its lower more narrowed outlet presents downward and backward.

Its shape has been resembled to a basin with two elevated alæ at its sides, from whence it has taken its name. But however little its osseous state may justify its name, yet when all the soft parts are moulded to them and the parieties are closed and perfected then it does resemble the thing after which it is named; it gives support by its alæ to the abdominal viscera and its cavity contains the bladder, uterus, and rectum.

Division :—The pelvis is divided into four bones, viz. the sacrum and os coccygis, situated superiorly and posteriorly, and the two ossa innominata, situated laterally, anteriorly, and inferiorly.

SACRUM.

This bone constitutes the posterior and superior part of the pelvis, and is in immediate connection, and a continuation of the vertebral column, under the name of *false vertebræ*. This bone is of a triangular shape, presenting its base superiorly, and apex inferiorly; it is concave anteriorly to lodge the rectum, and convex and rough posteriorly, to give origin to the erector muscles of the back.

Processes. *Base* or *body*, the upper thick portion of the bone resembling the body of the last lumbar vertebra, to which it is connected by the intervention of an interarticular cartilage.

Posterior arch, an angular shelving of bone, which is given off from the base or body, and which is resembled to the posterior arch of the vertebra. This process towards the lower part of the bone gets less evident until at last it diminishes into two

small points or tubercles termed cornua. The cornua then are the two prolongations of the posterior arch, which bound laterally the termination of the specus vertebrarum or spinal canal.

Two *oblique processes.* These resemble the oblique processes of the lumbar vertebra, and are situated at the junction of the posterior arch, with the base or body: they look backwards and inwards, and are articulated with the oblique processes of the last lumbar vertebra.

Two *alæ* or *transverse processes.* These form the thick sides or wings of the bone, and bear the same relationship to the body and posterior arch of the sacrum as the transverse process to the bodies and posterior arches of the spine.

Spinous process. This is the prominent extremity of the posterior arch, and forms a ridge extending from the upper part of the bone downwards through the median line of the back of the bone to the termination of the posterior arch where it verges into the two cornua.

Sets of *tubercles* are seen in pairs, extending perpendicularly downwards from the oblique processes and laterally to the spinous process. They decrease in size downward, and ultimately merge into the two cornua. These point out the sites of the undeveloped oblique processes.

Rough *ridges* upon the anterior surface of the bone extending between each pair of anterior foramina.

Lastly, the apex of the sacrum having a flat articular surface for the attachment of the os coccygis.

Foramina. *Specus vertebralis* or *canalis spinalis.*

This, like the specus of the vertebral column, is situated between the body or base and the posterior arch. It is of a triangular shape, largest at its superior part, and gradually diminishing as it descends with the lessening of the bone itself, until it becomes only a sulcus in consequence of the inferior part of the posterior arch being absent or converted into the two cornua. However, in the recent subject, this canal is completed by the membrana propria sacri. It contains the remains of the cauda equina which rapidly leave the vertebral canal through the anterior vertebral foramina.

Foramina vertebralia antica. There are four and sometimes five pairs, situated anteriorly between the body and transverse process of the sacrum. From them emerge the great sacral nerves as they go to form the sacral plexus on the anterior surface of the transverse processes of the bone; and small arteries enter from the median sacral to supply the parts with arterial blood.

Foramina vertebralia postica. These are not much smaller in the macerated state than the anterior, but so filled with the membrana propria in the recent state that they give passage only to small nerves appropriated to supply the muscles situated on the back of the bone; admitting also of arterial inosculation, through them, between the ramifications of the median sacral and the ischiatic and gluteal.

The muscles arising from the anterior surface of the bone are the pyriformes, which attach their slips between the foramina vertebralia antica.

The muscles arising from the posterior parts are the sacro-lumbalis, longissimus dorsi, and gluteus maximus, on both sides.

Fœtal state. In the fœtus this bone is divided into five distinct vertebræ, wherefore together with the os coccygis they are called the false vertebræ. Each bone was connected together by a distinct intervertebral cartilage: the ridges in front point out the former connections of the body, and the sets of tubercles behind the connection of the oblique processes. The great alæ or lateral processes are the transverse processes of these five vertebræ amalgamated together.

Connections. Superiorly, to the body and oblique processes of the last lumbar vertebra by the same kind of connection as that which exists between the vertebræ themselves; inferiorly, to the os coccygis by an intervertebral substance; and laterally, to the two ossa innominata in a manner hereafter to be described.

os coccygis.

This, during youth, and until after the meridian of life, consists of three moveable bones; the first of which is affixed by interarticular cartilage to the extremity of the sacrum. After that period all the parts join into one, which becomes an appendix by union of substance to the apex of the sacrum.

Processes, etc. The parts of the first bone are, two *cornua*, which ascend to become affixed to the cornua of the sacrum, and thereby complete the tuberculated sides of the extremity of the spinous;

and two *transverse processes*, which form the sides of the bone, and which complete the under parts of the foramina for the transmission of the last sacral nerves.

Those *of the second bone* are, a quadrangular body, with two articular surfaces above and below, by which it is connected to the other portions, and two small transverse processes at its sides.

The *third bone* is but a subrotundum of a cuboid form, with an articular surface on its upper part to attach it to the second bone before described. These give origin to the coccygei and sphinctor-ani muscles anteriorly; and posteriorly to the glutei maximi.

If a fourth bone exists then the third is of a somewhat flattened form before and behind, and has two articular surfaces above and below.

In women the connections of this bone ossify later in life than in men, and the two latter sooner than the upper bones. In fact, they do not ossify in women until nature tells them by this circumstance among the rest, that the period of parturition is passed away.

In the fœtus it is cartilaginous: a nucleus of bone is found in the body of the first portion, and sometimes in the second also.

FRACTURES OF THE SACRUM, ETC.

To cause fracture of the sacrum very considerable force is necessary, such as a violent blow, or the passage of a cart wheel across the bone. The alarming mischief following this accident chiefly results

from the damage suffered either by the pelvic viscera or by the sacral nerves; you will have your patient perhaps retaining his urine and fœces, or otherwise involuntarily discharging them, and you may have a paralysis of the lower extremities. The same line of practice must be adopted as that before mentioned, when treating of the fractured vertebræ, for the relief of these distressing results. As far as the mere fracture is concerned, nothing more is necessary than to lay the individual on his breast, apply leeches, cold lotions, or soap plaster to the seat of injury, as the necessity of the case requires, and use vigorous antiphlogistic measures. Attention must be paid to keep open the bowels and prevent retention of urine, by the use of clysters and purgatives in the one, and the catheter in the other case. If the anterior part of the bone is depressed inwards, then the treatment is the same as in the injury about to be described.

Fracture of the os coccygis. Here a piece is sometimes driven inwards: let the surgeon introduce the fore finger of his left hand into the rectum, and apply the other hand to the externals, and then reduce the parts, (let him oil his fingers well previous to the operation.) Nothing more is necessary afterwards than to prevent inflammation, or irritation of the extremity of the rectum, by keeping the patient in bed and on water gruel.

Dislocation of the os coccygis. Although rare, may yet be met with of two kinds; one outwards and the other inwards, the latter of which is always affected by external violence, the former by the

pressure of the head of the child in the process of labour. The symptoms of these two kinds of dislocations are too evident to require mention. Their reduction may be accomplished just as in case of fracture, but it is better left alone altogether. Oftentimes serious mischief arises from the proximity of this bone to the rectum, around which abscesses are liable to take place, or inflammatory swelling causing tenesmus and great pain in voiding the fœces, and indeed more serious constitutional fevers, the result of sympathy with the state of the rectum and soft parts adjoining.

OSSA INNOMINATA.

These form the lateral anterior and inferior parts of the pelvis; and because they are each divided into three portions in the fœtus, and the adoption of separate names and descriptions for the three portions is more conducive to their being rightly understood, that arrangement shall be followed here.

Each bone is therefore divided into the os ILIUM, situated superiorly, the os ISCHIUM, inferiorly, and the os PUBIS, anteriorly.

OS ILIUM.

This bone forms the expanded part of the os innominatum, being flat: its inner surface supports the viscera of the abdomen.

PROCESSES. Crista ilii. This is the waved upper edge of the bone which constitutes the prominence of the hip; it is of a rough thick elevated and sigmoid form, and gives attachment to the two obliqui

transversalis abdominis, et quadratus lumbarum muscles, it terminates anteriorly in the

Anterior superior spinous process. This anterior extremity of the crista ilii is formed for the attachment of the upper part of Poupart's ligament, and origin of the sartorius and tensor vaginæ femoris muscles.

Anterior inferior spinous process. This is a similar projection of bone less prominent, situated just below the superior, with a notch intervening between them; it gives origin to the upper part of the rectus femoris.

Posterior superior spinous process. This is the extremity of the crista ilii; below it, is also situated posteriorly, the

Posterior inferior spinous process: these processes give origin to the gluteus maximus, sacro lumbalis and fascia of the latissimus dorsi, as well as to processes of ligamentous substance, to be mentioned hereafter.

Peculiar parts. Three *notches*. 1. *Iliac notch*, this exists between the anterior superior and inferior spinous processes, and is altogether occupied by the iliacus internus muscle, as it is passing from the venter of the bone to the upper part of the thigh, under Poupart's ligament.

2. *Ilio-psoal notch*. This exists below the anterior inferior spinous process, and upon that part of the bone which contributes to the acetabulum, and is occupied with the bellies of the iliacus internus and psoas magnus muscles, as they are passing beneath Poupart's ligament.

3. *Sacro-iliac notch.* This is below the poste-ior inferior spinous process, and is completed into foramen, as we shall presently explain, by the schium and a ligament; it is occupied by the yriformis muscle, as it is passing from its origin n front of the sacrum outwards to the top of the high bone.

Two *surfaces* or *fossæ.* 1. *Fossa iliaca* or *venter.* The internal concave surface of the bone, giving origin to the iliacus internus muscle.

2. *Dorsum.* The external concavo-convex sur-face occupied with the origin of the gluteus medius, et minimus muscles: the lower thick part of the bone forms the *dorsum acetabuli*, from which arises the inferior part of the rectus femoris.

Two *lineæ.* 1. *Linea semilunaris.* A semicircle sometimes defined by a ridge of rough bone, di-viding the dorsum of the bone into two surfaces, the upper of which gives origin to the gluteus medius, the lower (which is above the dorsum ace-tabuli) to the gluteus minimus.

2. *Linea ilio-pectinea.* This is situated at the lowest part of the venter, and is very defined, being of a semilunar shape; it forms part of a circle which will be spoken of hereafter.

One *canal. Canalis medularis.* This is seen in the venter; it gives ingress to the chief medullary artery for the nourishment of the parts within.

Two *articular surfaces.* One below the dorsum acetabuli, forming the superior part of the aceta-bulum. One posteriorly to the venter, and be-tween that and the posterior spinous processes,

constituting two surfaces, the most anterior of which is its connection with the transverse process of the sacrum, by intervention of cartilage, forming the sacro-iliac symphisis; the most posterior is rough and gives attachment to ligaments hereafter to be mentioned.

OS ISCHIUM.

This constitutes the posterior and inferior part of the os innominatum. It is the next in size to the os ilium.

PROCESSES. *Body.* This forms the thick posterior part of the bone, and superiorly contributes to the inferior and posterior part of the acetabulum; some term it caput or head.

Cervix. This is the narrowed part of the body of the bone, immediately below the above-named portion; around this the tendon of the obturator internus winds.

Tuberosity. This is the inferior and posterior part of the body, it is covered in the recent state by cartilage; it is that part of the pelvis on which we immediately sit. It gives origin to the geminus inferior, triceps adductor magnus, biceps flexor cruris, semi-tendinosus, and semi-membranosus, as well as to the minor perineal muscle called transversalis perinei.

Spinous process. This is found parallel with the head of the bone, or on that part which forms the acetabulum, from which it projects backwards terminating in a point. To it is attached the sacro-sciatic ligament, whereby the ilio-sacral notch men-

tioned in the description of last bone, is converted into a foramen.

Ascending ramus. This is the anterior thinner part of the bone which stretches upwards from the body to become connected with the os pubis, from it arises externally the triceps aductor longus, et magnus, and internally the erector et crus penis.

Peculiar parts. One fissure:—*Fissura cotyloidea.* The cotyloid fissure is a sinus running into the acetabulum through a deficiency in the margin, and engaging the interior of that cavity to a considerable extent. It is not covered with articular cartilage; it is occupied by the triangular ligament of the head of the femur, by fat covered in by the synovial membrane, and by the articular arteries and veins. In the recent subject it is converted into a foramen by the continuity of the brim of the acetabulum being preserved by a strong ligament hereafter to be mentioned.

Three *notches.* The notch above the spinous process, termed the *sacro-iliac*, described partially in the account of the ilium.

The *sacro-ischiatic notch*, below the spinous process and behind the tuberosity occupied by the tendon of the obturator internus muscle: this is converted into a foramen by the inferior sacro-sciatic ligament, to be mentioned hereafter.

The obturator notch, forming part of the obturator foramen, to be mentioned hereafter also.

OS PUBIS.

This constitutes the anterior part of the pelvis,

and forms the least of the three divisions of the os innominatum. The bone is divided into three portions, viz. the body, the transverse, and descending ramus.

Processes. The body constitutes the most anterior part of the bone, and is situated beside the body of the os pubis of the opposite innominatum, and in the space between them, which is the median line of the human body, exists a fibro-cartilaginous substance, forming a connection called the *symphisis pubis;* from the anterior part of the body arises the gracilis and triceps adductor brevis; the posterior surface of the body is smooth and concave for the anterior surface of the bladder to rise against.

Crista pubis. This is the upper prominent part of the body, from which arise the rectus abdominis and pyramidalis, and on which is affixed the inner part of Poupart's ligament.

Transverse ramus. Stretching outwards from the body towards the acetabulum, of which it completes the anterior portion.

Linea ilio-pectinea. This is a continuation of the same line from the ilium, along the internal part of the transverse ramus, and ending in the crest of the pubis. It forms the inner veins to the pelvic cavity.

Descending ramus. This passes downwards and backwards from the body to unite with the ascending ramus of the ischium externally, it gives attachment to the adductor longus, and part of the gracilis, and internally to the erector and crus penis.

Peculiar parts. *Fossa pectinalis.* This is

situated upon the transverse ramus anteriorly to the linea ilio-pectinea, and between the body and acetabulum. It gives origin to the musculus pectoralis.

A *notch*, contributing to form the foramen thyroideum vel obturatorium.

Sinus obturatorius, situated internally and inferiorly to the extremity of the transverse ramus, forming the pudic part of the acetabulum, and in the notch for the thyroid foramen it gives lodgement to the obturator artery and nerve.

REVIEW OF THE PELVIS, ITS LIGAMENTS, AND CONNECTIONS.

Having then given a description of each portion of the innominatum, we will direct our attention more particularly to certain parts, to the formation of which all the bones are more or less contributary. The parts are the *sacro-iliac foramen*, completed by the sacrum ilium ischium and a ligament; the *sacro-ischiatic* foramen, completed by the sacrum ischium and a ligament; the *acetabulum*, completed by the ilium, ischium, and pubis; the *foramen thyroideum*, formed by the ischium and pubis; the *linea ilio-pectinea*, formed by the ilium and pubis; the *sacro-iliac symphisis*, completed by the sacrum, ilium, and ligaments; the *pubic symphisis*, completed by the bodies of the ossa pubis and ligaments; the *superior aperture* of the pelvis, formed by the sacrum ilium and pubis of each side; and *inferior aperture* formed by the coccyx, two ligaments, two ischiatic, and pubic bones.

1. *Sacro-iliac foramen.* This is formed by the

iliac notch of the os ilium, the spinous process of the ischium, the transverse process of the sacrum, and the superior sacro-ischiatic ligament.

The *superior sacro-ischiatic ligament* is attached posteriorly to the transverse process of the sacrum and os coccygis in an expanded form, and in combination with the sacral portion of the inferior sacro-ischiatic ligament; and anteriorly in a collected form to the spinous process of the ischium. It is therefore a triangular ligament, and is situated more posteriorly than the inferior, which crosses it on its anterior or pelvic side. Through the foramen thus formed the pyriformis muscle, the superior and inferior gluteal arteries and nerves, the internal pudic artery and nerve, the ischiatic artery, and great sciatic nerve, find their exit from the pelvic cavity.

2. *Sacro-ischiatic foramen.* This is formed by the spinous process and ischiatic notch of the ischium, the os coccyx, and the inferior sacro-ischiatic ligament.

The *inferior sacro-ischiatic ligament* is attached superiorly and posteriorly to the transverse process of the sacrum and os coccygis, where it is in union with the origin of the superior sacro-sciatic ligament; it descends outwardly so as to be attached inferiorly to the inner side of the tuberosity of the ischium. By this means it completes a foramen considerably smaller than the sacro-iliac, and of a triangular shape. Through this foramen the musculus obturatorius internus finds its way out of the pelvis, and the internal pudic artery and nerve re-

enter so as to come behind the ascending ramus of the ischium, which is occupied in the recent state by the commencement of the crus penis.

3. *The acetabulum.* This is completed by the extremities of the three bones, of which the ischium forms its largest portion. On dividing the cavity into fifths the ischium is seen to supply more than two-fifths, the ilium rather less than two-fifths, and the pubis one-fifth; the articular cavity is incomplete, as is also the circle of its margin in the osseous state, but in the recent subject a ligament stretches across, rendering its parietes more complete. (See description of hip joint.)

4. *Foramen thyroideum*, seu *obturans.* This is an oval foramen, completed by the transverse and descending rami of the pubis, and the ascending ramus and body of the ischium. It is an absence of bone where its place may be supplied by a softer and less ponderous structure without lessening the stability and strength of the parts. In the recent state it is almost filled with the *ligamentum thyroideum.*

The *ligamentum thyroideum* is a thin sheet of ligamento-membranous substance, attached to the circumference of the foramen thyroideum, with the exception of the superior part, where there is a separation of substance into two cornuated or luniform processes: one is attached to a line on the anterior part of the transverse ramus of the pubis on the anterior side of the sulcus obturatorius; the other is attached to a line which deviates from the margin of the thyroid foramen behind the acetabu-

lum. By this means a valvular foramen is formed at the upper part of the ligament, through which pass out of the pelvis the obturator artery and nerve. From the anterior side of the obturator ligament the obturator externus muscle arises, and from the inner or posterior the obturator internus.

5. *Linea ilio-pectinea.* This is the line of demarcation between the abdomen and the pelvis; it is formed by the iliac and pubic bones, it terminates anteriorly in the crest of the pubis, and posteriorly on the transverse process of the sacrum. It has been known to be so sharp as to have ruptured the uterus during the process of parturition.

6. *Sacro-iliac symphisis.* The connections between the rough surfaces upon the ilium and transverse processes of the sacrum is termed the sacro-iliac symphisis. It will appear evident to you that the sacrum is introduced between the ossa innominata in a wedge-like manner, so that the transverse processes of the sacrum overlap the inner surface of the iliac bones, while these bones stretch behind into the region of the back, and form prominences for the attachment of very strong ligaments. The immediate articular surfaces of the ilium and sacrum are divided into two parts; the anterior of which is riveted by alternate elevations and depressions existing in both these bones, and glued together by an *interarticular cartilage;* the posterior is rough and scabrous, and forms elevated and strong processes for the attachment of ligaments. These ligaments are the superior transverse, the inferior transverse, and the ilio-sacral.

The *superior* and *inferior transverse* run as so many separate distinct strong bonds of union between the posterior spinous processes of the ilium and the back of the sacrum; whilst the *ilio-sacral* stretch downwards and inwards from the posterior spinous processes of the ilium to the spinous process of the sacrum.

And lastly, the posterior part of the joint is strengthened by the origin of the lumbar muscles, and the connections of the sacro-ischiatic ligaments; and the anterior part by the membrana propria or periosteum of the pelvis becoming more distinctly ligamentous over the junction of these two bones.

As *appendices* to this joint, may be mentioned the synovial membranes or *bursæ adiposæ*, situated between the distinct ligamentous fibres of the transverse and ilio-sacral ligaments.

7. *Symphisis pubis.* This is formed between the bodies of the two ossa pubis. Its ligaments are the ligamentum capsulare, and the interarticular cartilage. The *capsular ligament* is attached to the margins of the bodies of the pubis, and forms a thin circle of ligamentous substance. Within the capsulic is contained the *interarticular cartilage;* this is a ligamento-cartilaginous substance, so binding the bodies of the two bones together as not to admit of the slightest motion, in fact it completes the bulwark of the pelvis anteriorly, and is the counteracting force against the power of the posterior symphisis in its grand purpose of retaining the continuity of the pelvic bones.

8. *The superior aperture of the pelvis* is formed

by the anterior part of the body of the sacrum, (which, with the intervertebral substance and body of the last lumbar, forms the *promontory*,) the transverse process and the lineæ ilio-pectineæ of the two ossa ilii et pubis. This is of various dimensions in the male and female pelvis; it assumes an oval form in the latter, having its greatest extent between the two iliac bones; whereas it is circular in the former, and its greatest extent is between the pubis and sacrum.

9. *The inferior aperture of the pelvis.* The same bones and ligaments which form the inferior aperture of the pelvis form also the boundaries of the perineum. For the perineum is not, as described by some, the space between and laterally to the opening of the bladder or uterus and the rectum; but it includes all these openings, and may be described as bounded *anteriorly* by the symphisis pubis; *posteriorly* by the os coccygis; *laterally* by the tuberosities of the ischium; *anteriorly* and *laterally* by the ascending rami of the ischium and descending rami of the pubis; and *posteriorly* and *laterally* by the two inferior sacro-sciatic ligaments. These are, then, the boundaries of the inferior aperture of the pelvis, which contains the terminations of the excretive organs, the bladder, uterus, and rectum, with their muscular and other appendages. This aperture also is necessarily larger in the female than in the male.

10. *Ligamentum poupartii.* This stretches from the anterior superior spinous process of the ilium, downwards and inwards across the iliac, and ilio-

psoal notches, and over the transverse ramus of the pubis, to be attached to the crista of the os pubis forming at this part a falciform appendix termed Gimbernat's ligament, which recedes from the under part of Poupart's ligament to be inserted for a short distance into the linea-ilio-pectinea. Beneath this ligament pass, the iliacus internus occupying the iliac and part of the ilio-psoal notches, the psoas magnus, the origin of the pectinales, the common femoral artery and nerve, the anterior crural and (sometimes the) external cutaneous nerve. (The order of parts is as follows: most externally the iliacus internus, and over it the external cutaneous nerve; more internally, the psoas magnus, and between the two the anterior crural nerve embedded in the cellular interstice; then more internally, the origin of the pectinalis, on which is situated outwardly the common femoral artery, and inwardly the femoral vein; most inwardly there is a cellular space which is occupied with crural hernia when it exists; so that you have the vein externally, the extremity of Poupart's ligament superiorly, and Gimbernat's ligament internally to the neck of the hernia.

General observations. Observe the *oblique* position of the pelvis, by which the lower part of the sacrum, etc. recedes from the central line of gravity. If you draw a supposed line through the substance of the bone from the promontory of the sacrum to the acetabulum, which must be semilunar, you will see that in the natural position of the pelvis, this bone is perpendicular, and if you join

the two supposed lines on either side, you have an *arch*, the base of which rests on the acetabulum on either side, and the apex is joined to or receives the central line of gravity; in fact, this arch is in the immediate course of, and is continuous with, that line. Continue these lines lower, so that the tuberosities of the ischium become the base of the arch, and then you see how the weight of the body is transmitted in the sitting posture to the seat on which these processes rest; or how, in the standing position, the thigh bones being at their extremities in the course of the line of gravity, they receive the weight of the body and transmit it to the feet.

Fœtal state. The following parts are cartilaginous in the fœtus; the crista ilii, the junctions of the three bones in the acetabulum, the spinous processes of the ilium and ischium, the crista pubis, the tuberosities of the ischium, and the extremities of the ascending and descending rami of the ischium and pubis.

DISLOCATION, FRACTURES, ETC.

Dislocation of the bones of the pelvis. Extreme violence is necessary to dislocate any bone of the pelvis, such as a fall from a very great height, or the passing of a waggon wheel over the sacrum, but in either case, a fracture would be the most probable accident; indeed, a dislocation does not frequently exist without a fracture more or less evident, or to a greater or less extent, as in Sir Astley Cooper's case, related in *Surgical Essays*, Part 1. The chief object in the treatment is to subdue the inflammatory

symptoms and relieve the paralysis of the bladder, and atony of the rectum, which usually result from such an accident.

Fracture of the os innominatum is not common, being only produced by certain accidents to which there is not much liability, such as the wheel of a waggon or the fall of a very heavy body. The violence which is necessary to fracture this bone is liable to induce more serious mischief to the organs contained in the pelvic cavity than could accrue from the mere fracture itself. As far as they are concerned, the treatment is very simple, because there is scarcely if any displacement, so that a soap-plaster and a bandage is all that is necessary for topical application. On the other hand, of course there is no accident which can require more rigid attention than such as this, where the utmost vigilance and most constant use of palliative and antiphlogistic treatment are so strongly indicated: but notwithstanding all which can be done in the way of diminishing inflammation, abscesses too often happen, especially if there be splinters of bone, detached and driven inwards; these abcesses, being deep-seated and producing great irritation, harrass the constitution with hectic, in which struggle too often the patient sinks. If paralysis of the bladder or retention of urine take place, then use the catheter; if there be much pain in evacuating the alvine secretion, then use clysters, and be sure to open abscesses at their dependent parts directly their existence is ascertained. Here also a little ingenuity is requisite to counteract the inconvenience

of motion, when it is necessary for the patient to relieve his bowels. Mr. EARLE's bed will be found of service.

SECTION III. THORAX.

The osseous thorax is a semi-cone, formed by the ribs laterally, the dorsal vertebræ posteriorly, and the sternum anteriorly. In the recent subject the spaces between the ribs are filled by the intercostales muscles and the superior part or apex of the cone, which is wanting in the osseous, is filled up by the scaleni and the organs of the voice, etc. and the inferior part or the base, is completed by the diaphragm.

STERNUM.

This bone constitutes the anterior part of the thorax, and is immediately subcutaneous.

It is divided into three portions or bones; the superior bone is described by some to resemble the heart drawn on a playing card, the middle is an oblong plane of bone, the inferior is a piece called ensiform, from its appearances.

FIRST BONE OF THE STERNUM. *Anterior surface*, rough and slightly convex, giving origin to the pectorales majores muscles.

Posterior surface, smooth and slightly concave, forming part of the cavity of the chest. Behind the *superior* part of this middle portion are situated the superior or descending vena cava, trachæa, œsophagus, etc., and behind its *inferior*, the anterior part or commencement of the arch of the aorta.

Upper margin, thick and broad, giving origin to the threo-hyoidei, and sterno-hyoidei internally; and sterno-cleido-mastoidei muscles externally. The angles of this upper margin form articular cavities for the internal extremities of the clavicles.

Under margin, thinner and narrower, and forming the medium of connection between this and the second part of the sternum, through the intervention of a cartilage which becoming absorbed in process of time, and bone being deposited in its place, the sternum is constituted one in substance, a *raphe* existing to point out the line of connection.

Lateral margins. These contain, superiorly, just below the articular depression for the clavicles on either side, a cavity for the cartilage of the first rib; more inferiorly, after a space of the margin somewhat smooth and rounded, a part of a second cavity for the insertion of the cartilage of the second rib. This is completed by a similar pit on the upper part of the second bone.

Parts of the second bone. This bone is of an oblong figure, and is considerably longer than the first but not so broad.

Anterior surface, which is hollowed in some, plain in others, and convex in a third class of subjects; likewise gives origin to the pectorales muscles, and insertion to the recti abdominis.

A posterior surface, smooth, against which pulsates the ascending or sinus aortæ, in concert with the pulmonary artery, both of which are involved in the upper part of the pericardium: between this latter capsule and the back of the sternum also is

formed, by the two pleuræ, the anterior mediastinum ; in which is situated on the posterior surface of the bone, the anterior thoracic duct, and remains of the thymus gland.

Superior edge, uniting this bone to the first.

Inferior margin, broader than the superior, and forming the medium of connection between this bone and the ensiform.

Lateral margins ; possessing parts of cavities for the second ribs, and complete depressions for the third, fourth, fifth and sixth ; and at its inferior part, a portion of a cavity for the seventh rib.

Parts of the ensiform, or third portion of the sternum. This is entirely cartilaginous in the young subject ; cartilaginous at its edges and osseous at its base in an adult ; and wholly osseous in old age. Its shape is so various, that perhaps it is scarcely the same in any two subjects ; it however consists of a *base*, which is the medium of connection to the second bone of the sternum ; and an *apex* which points downwards, and to which is attached the linea alba.

Fœtal state. In the fœtus these bones consist of six or seven pieces, each containing a centre of ossification in itself, and connected to the rest by cartilages. In process of time these ossify and leave a raphe upon each connection to shew their original division.

General observations. This bone partakes of a very slight elevation and depression of its lower part upon its upper, such as may be described as a yielding motion. It forms the fulcrum for the

motion of the clavicles which make a kind of ball and socket joint between their extremities and the first bone.

Fracture. This bone when fractured gives palpable evidence of its existence, so that the symptoms require no detail. The treatment is very simple; if there be no depression, apply merely a soap-plaster and a flannel roller, and bleed to prevent the more serious mischief of inflammation behind it, in the serous structures of the chest. Trephining is only necessary where there is much depression, or where caries of the bone has supervened and the diseased portion requires assistance to aid its separation.

COSTÆ OR RIBS.

The ribs form the side of the thorax by obliquely extending from the dorsal vertebræ forwards to the sternum. They are twelve in number on each side. They are incurvated, so that their exterior convexities form the boundaries to a cone, which gives strength to the chest, and their interior concavities give space to the thorax for the lodgment of certain vital organs, as the heart, lungs, etc.

Processes of a rib. *Head.* This is that part of the bone articulated to the vertebral column, which has upon its side two oblique articular surfaces, lined with cartilage. These surfaces are elevated into a ridge at their centre, which are opposed to the sides of the bodies of two vertebra and intermediate interarticular cartilage. Around these articular planes exists a rough surface for the attachment of the capsular ligament.

Cervix, or neck. This is only a narrowed prolongation of the bone extending from the head outwards, of a somewhat rounded form, having an elevation at its roots for the attachment of ligaments.

Tubercle. This is situated at the root of the neck, and is of an irregular form: it is on the exterior part of the bone, and has an articular surface lined with cartilage to form part of a joint between this and the transverse process of the vertebra.

Angle. Here the bone bends upon itself; before this, you observe also that it had made a flattish surface on which coursed the sacro-lumbalis muscles which ascend in fleshy slips to be inserted on these angles.

Shaft. All the curved part of the bone anterior to the angle is called by this name; it consists of an external and internal smooth surface of dense bone, and between them a structure analagous to the diplöe of the skull.

Margo rotundus is the upper round smooth margin of the shaft, into which are inserted the intercostales externi et interni muscles and levatores costarum.

Margo acutus. The under sharp spinous ridge of the shaft, from which arise the intercostales interni et externi.

Sulcus intercostalis runs along internally to the acute margin, and is the channel for the intercostal artery and nerve: this sulcus insensibly diminishes towards the extremity of the bone.

Fossa ovalis is the extreme oval pit, to which the cartilage of the rib is appended.

Fœtal state. In the fœtus, the head, tubercle, and extremity of the rib form thin epiphyses to the shaft. By this it may be seen that, in proportion, the cartilages of the ribs are longer in the fœtal than in the adult skeleton.

Connection and ligaments. *Articular surfaces and ligaments of the vertebral extremity of the rib.* The head of the rib is opposed to the half articular surfaces upon the sides of the bodies of the two vertebræ to which it is connected, and the intervertebral cartilage. The transverse process of the vertebra and the tubercle of the ribs form another joint.

Lig. capsularia exist between each of these, being connected to the circumference of the articular surfaces on each of the bones.

Lig. interna transversaria are attached superiorly to the transverse process of the vertebræ, and inferiorly to the spinous ridge or tubercle on the necks of the ribs.

Lig. externa transversaria are attached superiorly to the same part of the transverse processes of the vertebræ as the last, but pass directly downwards, (whereas the former pass forwards and downwards,) to be attached inferiorly to the superior and posterior parts of the necks of the ribs.

Lig. cervicalia externa costarum, attached superiorly to the exterior rough surfaces of the superior oblique processes of the vertebræ, and descending forwards obliquely, are attached inferiorly to the external and superior parts of the necks of all the ribs.

Connections and ligaments of the sternal extremities of the rib. The ribs are connected to the sternum by means of intermediate cartilages.

These cartilages have an anterior and posterior smooth surface lined by perichondium. Their costal extremities are riveted in the fossæ ovales of the ribs, and strengthened by anterior and posterior ligamentous fibres. Their sternal extremities form joints, each having capsular ligaments and being strengthened by the ligamenta radiata, which are attached to the anterior surfaces of the cartilages, and then spread in a radiation upon the sternum, contributing to form the

Membrana propria sterni. This is an expansion of ligamento-membranous substance, extending all over the bone, chiefly in a longitudinal direction. It is so implicated with the periosteum as to be inseparable.

Peculiarities of individual ribs. The first seven ribs are all denominated true, either because their cartilage are affixed directly to the sternum, and thereby constitute the thoracic boundary, or that they form the true defence to the vital organs of the thorax, which the latter five do not. Observe also the ribs increasing in obliquity of direction from the first downwards.

First rib is situated transversely, and is semilunar in form, having a superior flat surface opposed to the neck, and an inferior flat surface apposed to the second rib and thorax, instead of an anterior and posterior surface, as in other ribs. The head is circular and contains but one articular

surface. The neck is more perfect in this than in the other ribs. There is no groove nor any angle, the bone being semilunar, as before said. On its upper surface may be seen a *tubercle* for the insertion of the scalenus minor, and an oblique sulcus caused by the passage of the subclavian artery, as it is emerging from the cavity of the thorax into the neck. And lastly, a second tubercle or rough surface is seen near the extremity of the bone, for the insertion of the scalenus anticus The rest of the upper part of the bone beside the oblique depression is occupied by the insertion of the scalenus anticus et medius muscles. The cartilage of this rib is very short and gives origin to the sterno-thyroideus muscle.

From the first to the seventh the ribs lengthen, they then decrease in like proportion to the twelfth. The cartilages also lengthen and approximate to each other from the first to the seventh.

The cartilages of the false vertebræ are not connected to the sternum but to each other, and to those of the sixth and seventh true rib, whereby the margin of the thorax is rendered cartilaginous.

The *eleventh rib* is small, less curved, has no sulcus intercostalis, its margin sharper above, has but a very short cartilage, and no tubercle, as its connection to the transverse process is merely ligamentous.

The *twelfth rib* is a spicula of bone somewhat less incurvated than the eleventh: it has no double articulating surface on its head, as it is only articulated to the twelfth dorsal vertebra; no tubercle

or articulation with the transverse process; no fossa for the intercostal vessel and nerve; and no oval depression for the cartilage, but generally ends in a sharp spine. This rib, with the eleventh, because they are enveloped in the muscles, are termed *floating*.

General observations. The formation of the chest has a considerable influence upon the vigour and stamina of the health of all individuals. Where the sternal bones are flat and contracted, the persons so formed are subject to consumption; in scarcely any who enjoy good health, and are of a robust and manly form, will the chest be found flat-breasted. Difficulty of breathing, palpitation, an anxious countenance, and a short dry hacking cough, are frequently the result of the consequences of malformation or imperfect developement of the chest, and the latter are induced very frequently by bad nursing and supporting the child on its breast, or letting it lean too much forward.

By a review of the modes of connections existing between the ribs and the spine, we see that motion is allowed upwards and downwards, but that it is prevented in any other direction. This motion is a slight rotatory one, and although it be limited in the individual, it is extensive in the aggregate: so that by the action of muscles the ribs are made to expand and enlarge the cavity of the chest, and then subside and contract it, in aid of the function of respiration.

Fractures of the ribs. A fracture generally occurs anteriorly to the angles which are the most

prominent parts of the ribs: it generally implicates two or three bones. To detect a fracture, place your fingers upon the spot where pain is seated, and, pressing, desire the patient to cough, when a crepitus may be often distinguished.

A fracture of the ribs cannot displace them in any other direction than outwards or inwards: because they are tied at their two extremities, and the same muscles are situated between them, so that, in fact, they are kept in their proper place, unless the force has been great enough to depress them. Nothing need be done in the treatment of them than to make the patient lie on the affected side in bed, or apply soap-plaster and use a linen bandage. If the lungs be wounded so as to cause emphysema and extravasation of blood, make small punctures in the skin near the fracture, to let out the air from beneath the common integuments: but if the symptoms are urgent, make a free incision into the cellular membrane, and a smaller puncture into the thorax. Blood-letting from the arm, and using other antiphlogistic measures are highly proper. If there be a cough, giving pain by attriting the fractured ends of the bone together, use opiate mixtures and other remedies to counteract irritation.

CHAPTER IV.

INFERIOR EXTREMITY.

This consists of the os femoris, patella, tibia, fibula, tarsus, and metatarsus.

OS FEMORIS.

The femur is the longest and strongest cylindrical bone.

Ten Processes. *Caput* or head. This is the round orbicular process, constituting the most superior part of the bone. It is covered with articular cartilage and comprehends a considerable part of a sphere, forming the ball to the hip joint. On its *internal* side there is a small depression not covered with articular cartilage for the attachment of the ligamentum rotundum, hereafter to be described.

The *cervix* or neck is the truest specimen of a neck of a bone to be met with in the skeleton, being the largest: it stretches from the head obliquely downwards and outwards to the shaft, thereby separating them, and affording a longer lever for the more extensive and powerful motion of the thigh. The neck gradually widens in its descent; its surface is foraminulated for the insertion of the reflected ligamentous bands of the capsule.

The *trochanter major* is a rough elevated process, situated at the outer part of the root of the

neck: it is convex externally for the attachment of of the gluteus maximus et medius muscles; it is concave externally for the insertion of the pyriformis, geminus superior, obturator internus, geminus inferior, and obturator externus.

The *trochanter minor* is a smaller pyramidal process, situated internally and inferiorly to the major, and likewise at the root of the neck; it receives the insertion of the psoas magnus and iliacus internus muscles, the flexors of the thigh.

The *linea quadrata*, a marked ridge upon the *posterior* part of the bone, at the root of the neck, stretching between the two trochanters, gives attachment to the quadratus femoris muscle, and the capsular ligament.

The *linea inter-trochanterica* is an oblique ridge seen between the two trochanters on the *anterior* part of the root of the neck; it serves to give attachment to the capsular ligament.

The *shaft* or *body* of the bone forms an angle with the head and neck, and is found to bend forwards and incline at first apparently outwards; but subsequently to approximate inwards toward the thigh bone of the other extremity, in order to reincounter the central line of gravity. It is convex anteriorly, flat laterally, and forms a prominent ridge posteriorly, which will be separately described. Anteriorly it gives origin to the crureus, laterally it is covered with the two vasti; which occupy with their origins the whole surface of the sides with the exception of a small space on the inner side of the upper part of the lower third of

the bone, which has no muscle arising from it at all. The whole shaft is longitudinally arcuated, presenting the convexity in front.

The *linea aspera* is the rough double ridge on the posterior part of the shaft of the bone. It commences by two oblique ridges extending from each trochanter, inwards to a convergence toward each other, and uniting in the lower part of the upper third of the shaft into one spine: it is continued down the median line of the bone, posteriorly, as far as the upper part of the lower third of the bone, where it again divides into two ridges going to the two condyles. It gives insertion to the gluteus maximus, tricipites, and pectinales muscles, and origin to the vastus externus, vastus internus, short head of the biceps, and commencement of part of the gastrochnemius.

The *condyles*, *external* and *internal*, form the extremity of the bone where the shaft abruptly enlarges into two prominent convexities, covered with articular cartilage. The external condyle is smaller than the internal, and gives origin to the plantaris and popliteus muscles, and external head of the gastrochnemius. The internal condyle is the largest and lowest, by which means the obliquity of the shaft of the bone is counteracted. It gives origin to the internal head of the gastrochnemius.

Four Fossæ. The *fossa trochanterica* is the internal concave surface of the trochanter major, it has been already mentioned as giving insertion to the rotators outward of the thigh, the gemini, pyriformis, and obturatores externus et internus.

The *fossa poplitea* is the space between the bifurcation of the linea aspera and the two condyles in the ham. It contains fat, the popliteal artery and vein, and posterior tibial nerve.

Fossa trochlearis. The angular depression on the anterior part of the extremity of the bone, lined with articular cartilage; it is named from the patella, which plays upon this part of the joint.

The *hyatus condyloideus* is the gap between the condyles, giving lodgement to the crucial ligaments and popliteus muscle.

Fœtal state. In the fœtus the trochanters, head, and condyles are cartilaginous until puberty, these parts form epiphyses.

DESCRIPTION OF THE HIP JOINT.

This is a *ball and socket* joint; the articulating bones are the acetabulum and the head of the femur.

Ligaments. Ligamentum capsulare. This is a strong ligament composed of two coats; an outer fibro-ligamentous, and an inner membranous or synovial. The inner membrane is seen to line the cavity of the acetabulum, and to be reflected forwards, over the ligamentum rotundum, to the head of the femur, over which, and its neck, it is continuous with the loose part forming the lining of the ligamentous capsule, as in other joints. The external fibro-ligamentous coat is attached superiorly to the circumference of the acetabulum, and inferiorly to the root of the neck of the thigh bone, or to the roots of the trochanters and to the lineæ intertrochanterica et quadrata. The capsular ligament

is most thin at its internal and anterior part, where it is protected by the psoas magnus and iliacus internus muscles: more externally or at its anterior part it is thicker and covered by the origin of the rectus femoris muscle. Externally it is very thick being strengthened with fibres of ligamentous substance from the dorsum ilii, and covered distantly by the extensor muscles and fascia lata femoris: posteriorly it receives an accession of substance and strength from the rotator muscles which lie immediately upon it.

Ligamentum rotundum, (or rather more properly speaking, *triangulare*) begins with a broad expanded portion attached to the inarticular depression at the bottom of the acetabulum, and to the ligamentum transversale: it narrows, and becomes rounded in form and is attached in a collected manner to the depression on the head of the femur. It is covered with synovial membrane, and is implicated in the substance occupying the cotyloid fissure and bottom of the acetabulum, termed the massa synovialis or gland of the joint; which fills up all that part of the acetabulum not lined with articular cartilage. The design of this ligament is to prevent dislocation; in which accident it must be necessarily broken. The design of the gland of the joint is, to secrete synovia for the purposes which are mentioned in the preparatory chapter.

Ligamentum transversale. This ligament forms a bridge across the cotyloid fissure: and is attached superiorly to the margin of the articular surface of the os pubis, and inferiorly to the margin of the

articular surface of the ischium. This is a very strong ligament and restores the circle of the margin of the acetabulum. Beneath it an articular artery enters the synovial substance which occupies the cotyloid fissure.

Ligamentum orbiculare. This is a cartilaginous band, extending in a circle from the margin of the acetabulum and ligamentum transversale, by which means the socket is deepened: a section of it appears triangular, and its outer part is convex in correspondence with the convexity of the dorsum acetabuli, while its inner part is smooth and lined by synovial membrane.

DISLOCATIONS, FRACTURES, ETC.

There are four kinds of dislocations of the head of the femur: *upwards* and *outwards* on the dorsum ilii; *upwards* and *inwards* on the transverse ramus of the pubis; *downwards* and *inwards* on the foramen thyroideum; and *downwards* and *outwards* on the os ischium. The dislocation upwards and outwards is the most frequent, and the dislocation downwards and outwards the most rare.

Dislocation of the thigh bone upwards and outwards on the dorsum ilii. On a general view, the extremity of the injured side will be found much shorter, because the dorsum acetabuli is higher than the socket, and the head of the bone has exalted itself; the toes of the affected limb will also be turned inward, toward the ancle of the opposite limb, because the tricipites have a greater power of action and the head is retroverted on an eminence

instead of being inverted in a cavity. On particular examination a prominence will be felt beneath the inferior parts of the tensor vaginæ muscle, which is the head of the bone, and the trochanter major will be found of course to have followed the head and to have exalted itself out of its usual position to a parallelism with the cavity of the acetabulum. If you try to move the limb, which for the sake of *doing* something and appearing very assiduous, you may be led early to attempt, you will find all your endeavours at rotation *outwards* fruitless, whereas you may increase the rotation inwards with facility. You cannot mistake this dislocation for a fracture of the neck of the bone, inasmuch as there are no other correspondent symptoms beside the shortening of the limb. Lay your patient on his uninjured side, on a firm bedstead or table; and fix him there after the following manner. Pass a reel towel if you have nothing else, or a belt of some sort, over the ilium of the affected side, and then bringing it over his opposite, either let it be firmly held by assistants, or tied to the bed-post or to some other fixed body: else you may pass a folded sheet or reel-towel across the perineum and bring one end before and the other behind the patient, letting them be secured by assistants, or by fixture to some immoveable body, but I think the former the best practice of the two. Having your patient fixed, it is your next object to make extension. The principal obstacle to extension is muscular force, but this cannot be overcome by counter-force. Extension to be effectual, must be made in the line of

the direction of the limb, gradually and unremittingly. You may use the limb as a lever, or may affix the towel just above the knee (which is the most usual practice,) and then gradually, but unremittingly, continue your extension downwards and inwards towards the opposite extremity. If, however, you find your patient using muscular force, whether voluntarily or spasmodically, then you will subdue this by a plentiful evacuation of blood from the arm, and should he faint, so much the better, for you can now succeed on re-commencing your extension; when you have brought down the trochanter major to its original situation, you will know it by the *ability to rotate the leg outwards*, which will, in fact, place the head in the socket of the joint. Now bandage the patient's thighs together midway between the hip and the knee, and lay him straight in the bed, where he must continue for the space of a month, contenting himself with low diet, and rigidly avoiding any irritating food or unnecessary movements of body. It will be also proper to rub the region of the hip with camphor liniment, or some other stimulating application.

Dislocation of the femur downwards and inwards. This kind is a frequent accident, because the thigh possesses great latitude of abduction, the acetabulum is not osseous at its internal edge, and the ligamentum rotundum does not oppose; the head of the femur rests upon the obturator or thyroid foramen. Here we have the inferior extremity lengthened, because the head is lower than the acetabulum; the trochanter is also lower and the abductor muscles are

stretched, and the buttock is flattened. The head of the bone may be felt between the trochanter, now much lower than natural, and the parts of generation; the leg is rather bent, the knee and foot are turned outwards. In order to reduce this, having fixed the pelvis, make extension downwards and outwards, in order to disengage the head from the foramen, and this effected, the muscular power will restore it to its proper situation. The same after-treatment is requisite here as described in the last.

Dislocation upwards and inwards. Here the head is distinctly felt upon the transverse ramus of the pubis, and a cavity is perceptible at the site of the acetabulum; the leg is neither lengthened or shortened, inasmuch as the head is on a parallelism with the acetabulum. The foot is rotated very much outwards and the knee is turned backwards. In consequence of the mechanical pressure of the head upon the femoral vessels and nerves, the numbness and pain of the limb are very frequently extreme. Now in the reduction of this some have recommended making the extending force in the same direction as the latter; but let them recollect that the head of the bone is not lower than the acetabulum; and therefore others have more properly directed that the extension should be made directly outwards. This is done by placing the circle of a towel to invest the highest part of the thigh, and to pass before and behind it directly outwards; and while the assistants are making extension in this direction, the surgeon is to elevate the knee gra-

dually into a right angle with the body, then to turn it a little inwards, by which means the head of the bone will slip into its proper cavity. The after-treatment is the same as before detailed, with attention also to the effects of the late situation of the head of the bone upon the femoral vessels and nerves.

Dislocation of the thigh downwards and outwards brings the head of the bone upon the spinous process of the ischium, or into the sacro-ischiatic foramen, and lengthens the leg very slightly, turning it either outwards or inwards as the dislocation is either primitive or secondary. When the dislocation becomes secondary, (which frequently happens) the foot is turned inwards. This cannot be mistaken for a fracture, inasmuch as the leg is lengthened, the projection of the trochanter is lost, and a hard tumour is discoverable at the posterior and inferior part of the nates. Having fixed the pelvis, make extension downwards, forwards, and inwards, to dislodge the head from the foramen, and then push, with the extremity of the thigh, the head into the acetabulum; or else pull it in, by passing a towel around the upper part of the thigh and making extension with its ends over the hip of the patient. If this practice does not succeed, then having previously drawn up the thigh towards the abdomen and approximated it to the other extremity, pass a roller around the thigh just above the knee, and make extension outwards and a little upwards. If, by these means no success reward the utmost endeavours of the surgeon, he

must console himself with the reflection that failure is a frequent consequence of this untoward accident, and not by any means a proof of want of skill.

Fracture. The femur is most usually fractured in its shaft, although every point of the bone is liable to that accident, whether it be the head and the superior epiphyses on the upper part of the shaft, or the condyles at its lower end. Its liabilities to fracture are very great, from the important office which it has to fulfil, and the strength of the muscles. The nature of the accident is likewise as varied as are the points of fracture; sometimes transverse, more frequently oblique, occasionally comminated or splintered, or at other times compound. Three classes of fractures may be distinctly mentioned, viz. the fractures of the shaft, those of the neck, and those of the trochanters and condyles, or epiphises. The varieties of the three species are so numerous, that it would too much extend the limits of the work to treat of them.

Fractures of the shaft may be known by symptoms common to, and usually attendant upon fractures in general: these are pain, inability to move, deformity, shortening of the limb, etc. The three plans which are adopted by surgeons in the treatment are the straight position by Desault, the lateral and flexed, by Pott, and that of the inclined plane. It is not for us here to enter into the merits of the three plans; suffice it to say that Pott advocates his on the principle of relaxing the muscles in contact with the shaft; Desault, upon extension and compression; and the inclined plane is in use, they say, in subordination to both intentions.

Desault's plan has obtained general practice. He lays the patient, in a strictly horizontal posture, upon a hard mattrass not given to yield. He coapts the fractured portions by gradual and gentle extension, and then proceeds to retain them in apposition by means of an apparatus bearing out this proper principle. Linen dipped in evaporating lotion, and Scultetus's bandage, likewise wet, are applied along the limb. Then the hollows between the nates and the under part of the thigh and the ham, are filled with compresses of linen and tow, to render the under part of the limb uniform in its pressure upon the bed. Subsequently a long splint is passed down the outer side of the limb, from the pelvis to below the foot, having circular holes cut in certain parts to adapt it to the eminences of the knee and ankle; and the hollows caused by the inflections of the limb around these prominences filled with compresses of linen or tow. Another splint less in size is placed along the inner side of the limb, from the sub-pubal portion of the thigh to below the inner side of the foot; and a third along the anterior side of the limb; this latter may be but of sufficient length to stretch along the thigh only. As the external splint is of chief importance, so the surgeon must be particular in well adapting and fixing it. The points for fixture are around the pelvis, above and below the knee, and at the ankle. The foot must be fixed by a roller, to prevent its moving.

Fracture of the neck, a more frequent accident than dislocation of the head of the bone, may be mistaken for the latter, but that in every instance

there is a manifest shortening of the limb, accompanied with great movability, so that it may be reduced to its proper length and form, without much resistance; notwithstanding which it returns to its deformity when extension ceases. The toes are also usually turned outwards.

Fracture occurring *within* the capsule, an accident generally of old age, has never been known to unite by osseous deposit, although the patient has after a considerable length of time been able to walk, by ligamentous adhesions, irregular though they be, supplying the place of callus. Fracture *without* the capsule, or, that is to say, at the root of the neck, is a more frequent occurrence in youth, is attended with considerably more pain, less motion, and a distinct crepitus. The double inclined plane has been recommended as the best position in the treatment of these. Sir Astley Cooper, in the former case, places the limb lengthways upon a pillow, which is crossed by another under the knee, whereby a gentle flexure is permitted. This is continued for a certain length of time, when the patient is allowed to sit, and then to walk with crutches. In the latter case, continued extension is made by a splint fixed to the outer side of the thigh, by means of a belt around the pelvis, and a bandage above the knee. This must be maintained for a considerable length of time, at least eight weeks, when the patient may leave his bed, but the splint had better be retained three weeks longer.

Fracture of the trochanter major should be treated

thus. Place the patient in the horizontal posture; appose the broken parts; put a compress above and behind the trochanter, and firmly fix it there by a bandage passed around the limb; a splint may be placed along the outer side of the limb, and secured at its two extremities, on the pelvis, and at the knee.

TIBIA.

The tibia, so called from its supposed resemblance to a musical wind instrument in use among the ancients, forms the inner and largest bone of the leg, is in direct line with the thigh bone, and has alone to do with the formation of the lower part of the knee joint. One of its very distinguishing characteristics is its triangular form, particularly its triangular large head, from which the bone tapers irregularly towards its extremity, which again is seen a little to increase in size.

For the sake of description we will divide the bone into HEAD, SHAFT, and EXTREMITY.

The HEAD, the largest and most superior part of the bone, is broadest above, where it presents two surfaces of an oval form; depressed or socketed, and covered with articular cartilages called the *fossæ condyloideæ;* these are separated by a double elevated *tubercle*, with rough depressions before and behind, which are occupied with the anterior and posterior crucial ligaments. The anterior of these *crucial fossæ* is marked by a slight ridge, which separates this from an articular surface against which the inferior-most part of the patella is

opposed, in certain positions of the knee joint. The posterior crucial fossa is very large and defined, and less marked, though deeper than the anterior.

[We have, then, upon the superior part of the head of the tibia, the two fossa condyloideæ, which form the sockets for the condyles of the femur; the tubercle, double and rough, which gives attachment to the semilunar cartilages and their internal ligaments; and the anterior and posterior crucial fossæ, for the attachment of the crucial ligaments of the knee joint.]

On the anterior surface of the head observe the *anterior tubercle*, or *processus patellæ*, above which the bone seems to be flattened into an angular oblique plane. This process is formed for the implantation of the ligamentum patellæ, and the above-mentioned inclined surface is covered with a bursa mucosa, or synovial bag, which intervenes between it and the ligament.

The posterior surface of the head has a superficial fossa, which is occupied with the belly of the popliteus muscle, and is therefore termed *fossa poplitea.*

The external surface is peculiar from possessing an articular depression for the head of the fibula.

The internal surface is not remarkable for any thing more than its greater extent and unbroken roundness, which is uninterrupted, like the external, by any articular depression. It gives origin to the tibialis anticus, and insertion to the gracilis, sartorius, semitendinosus, and semimembranosus.

Lastly, observe the circumference of the head of

the bone, porous and rough for the insertion of the capsular ligament, and attachment of the semilunar cartilages, hereafter to be mentioned.

The SHAFT of the bone is triangular, and largest where it joins the head, from which it gradually diminishes in size downwards unto the lower third, where it assumes an oval form, and a little increases to give surface to the articulation of the ankle joint. It has three margins and three surfaces.

The *anterior margin* is a waved spine, extending throughout the front of the bone, from the anterior tubercle towards the inferior third, where it is bifurated into two faint lines, the chief of which is lost in the malleolus.

The *external spine* is sharp and somewhat straight, stretching from beneath the head and articular depression for the fibula, directly downwards, dividing the external side of the bone into two surfaces. It is lost at the extremity of the bone in the hollow for the malleolus externus. It gives attachment to the interosseal ligament, except at its upper part, where the tibialis posticus arises.

The *internal spine* is very prominent at the middle third of the bone, and rounded just beneath the head; it is sharp at the lower part of the shaft, where it is lost in the malleolus. From the middle third of this spine the soleus arises.

The *internal* surface is smooth and semilunar, being covered by fascia and common integuments.

The *external* surface, or that opposed to the fibula, is hollowed, giving origin to the tibialis anticus, through the two superior thirds of its extent.

The *posterior surface* is crossed obliquely at its superior third, by a line stretching from the articular depression for the fibula, downwards and outwards, to the internal spine, which it joins at its middle third. This is called the linea solea, and serves to point out the seat of the origin of the soleus muscle, and the insertion of the popliteus, which of course occupies that space above the line. The posterior surface further gives origin to the tibialis posticus at its external superior and middle part, and to the flexor longus digitorium at the internal middle and inferior part.

The *canalis medullaris* obliquely enters the bone at the posterior surface, in the lower part of the upper third.

The EXTREMITY of the bone rather increases in size, having flat anterior, internal, and posterior surfaces. In front it is crossed by the tendons of the tibialis anticus, extensor proprius pollicis, and longus digitorum muscles, behind it is opposed to the tendon achilles.

The *malleolus internus* is a process jutting down from the lowest part of the bone, at its inner side; it serves to form the inner buttress to the ankle joint, and gives attachment to strong ligaments; its external surface is articular, and forms part of the *greater scaphoid cavity*, which is the large articular socket of the ankle joint; it is broadest externally, and narrowest at the malleolus internus.

The *lesser scaphoid cavity*, also articular, upon the outer side of the extremity, gives lodgement to the extremity of the fibula or malleolus externus.

In its *fœtal state* the bone is divided into three parts. The extremities are epiphyses, the shaft is ossified.

FIBULA.

This is a long slender bone, with two bulbous shaped extremities. It is situated at the outer side of the leg.

It is divided into three parts;—the *head*, *shaft*, and *extremity*.

The HEAD, which is the superior bulbous extremity of the bone, is irregular and rough on its external, anterior, and posterior sides, and smooth on its internal and superior, where it is covered with articular cartilage, and is in apposition with the side of the head of the tibia. On the superior part of the head there is a projection or *tubercle*, giving attachment to the inferior part of the external anterior lateral ligament of the knee joint. On the *posterior* part of the head of the fibula there is a projection, or *tubercle*, giving attachment to the tendon of the biceps flexor cruris, and a flat smooth surface above, where a bursa mucosa intervenes between it and the tendon. On the anterior part of the head also a *tubercle* is seen which gives attachment to ligaments binding it to the head of the tibia.

The SHAFT of the bone is irregular, a little incurvated, and assumes somewhat a triangular figure; consequently, for the sake of description, we will divide it into *three ridges and three surfaces*.

The *external ridge or spine* is very evident, and rises on the outside of the head of the bone, descends through the two superior thirds of the outer side,

and in the lower third is seen to wind round to the posterior side of the shaft.

The *internal ridge* arises upon the head immediately below the articular surface thereon; descends very prominently along the two superior thirds of the inner side of the shaft, posterior to the internal spine: in the lower third it unites with a ridge, arising also upon the head and forming a curve in its course: it gives attachment to the interosseous ligament.

The *anterior ridge* arises from the internal, in the upper third of the shaft at its inner side: it descends at a slight divergence from the inner spine, becoming gradually more marked; in the lower third it divides into two ridges, the external of which terminates on the outer side, and the internal on the anterior side of the malleolus externus.

The *anterior surface* is situated between the external and internal spines, and is crossed and divided into two, by the anterior spine.

The *external posterior surface* is between the external spine and the curved posterior line before mentioned, as merging into the internal spine. This surface, which is external in the upper third of the shaft, is completely posterior in the two lower.

The *internal surface* is the smallest of the three, and is comprised within the curved posterior line, and the internal spine.

Now observe how these parts of the fibula are occupied with the *origin of muscles*.—The anterior part of the head, and two superior thirds of the external spine and external surface, are occupied by the origin of the extensor longus digitorum;

the posterior part of the head, and two superior thirds of the external spine, by the soleus; the internal and inferior part of the head, and the posterior curved line,* and the whole of the internal surface between that and the internal spine, by the tibialis posticus;—the external side of the head, and the two superior thirds of the external spine and anterior surface, by the peroneus longus;—the two inferior thirds of the anterior and external angles, and anterior surface, by the peroneus brevis;—the two inferior thirds of the anterior angle and surface, by the extensor proprius pollicis;—the anterior surface between the bifurcation of the anterior angle in the lower third of the shaft, by the peroneus tertius;—and lastly, the whole length of the posterior surface, to within an inch and half of the malleolus, by the flexor longus pollicis.

The EXTREMITY of the shaft is the *malleolus externus*, which forms the prominence of the outer side of the ankle, which is larger and more posterior than the inner ankle, or malleolus of the tibia, whereby the joint is rendered stronger, and the foot allowed to be turned outwards. The malleolus is naturally divided into three surfaces. An *internal*, which is slightly concave, lined with articular cartilage, and constituting part of the ankle joint. An *anterior* surface, which is scabrous, and gives attachment to the ligamentum tarsi annulare anticum, under which also it is crossed by the tendon of the peroneus tertius. The *pos-*

* This internal semilunar line separates the tibialis from the flexor longus pollicis.

terior surface is smooth, being grooved by the tendons of the peronei, longus et brevis; these are, at the same time, under the ligamentum tarsi annulare posticum externum, which is also implanted upon the posterior surface of the malleolus externus. The *inferior* part of the malleolus is eked into a *coracoid process*, to give attachment to the three ligaments which strengthen the outer ankle.

The *canalis medullaris* is seen in the middle third of the posterior surface, slanting downwards and inwards, to the centre of the bone.

Fœtal state. In the fœtus the shaft is ossified, but the head and malleolus are cartilaginous; these subsequently form epiphyses.

Observations. This bone contributes very largely, as we have shewn, to the origin of the muscles of the foot and toes; it likewise forms a line of fixture for the interosseous ligament which serves the same intention; thus we have, by this arrangement, great surface without much weight.

Connections and ligaments of the heads of the fibula and tibia. The *capsular* ligament attaches itself to the circumference of the articulating surface, on the side of the head of the tibia internally and superiorly; and to the head of the fibula externally and inferiorly: and ligamenta transversaria, which are merely strengthening bands of ligamentous fibres, stretch across before and behind the capsule. This connection is *arthrodial*, where little if any motion is allowed. There is a bursa mucosa situated upon the head of the fibula between that and the tendon of the biceps f. cruris. The fibula

sometimes forms a part of the knee joint; a variety of this kind came under my notice in the case of a soldier who had his leg shot off very near the knee joint, with which the external wound communicated when the head of the bone was removed. I know not whether it be very common or not.

The connection between the shafts of the tibia and fibula is the *interosseous ligament*, which is merely a sheet of dense ligamentous substance stretched between these bones, and attached to the external spine of the tibia and internal spine of the fibula throughout their whole extent, with the exception of about an inch beneath the heads of the bones where the interstice is occupied by the origin of the tibialis posticus, and anterior tibial vessels. The fibres of this ligament are oblique, and form two sets which decussate; it is moreover pierced with numerous foraminulæ, through which inosculating arteries transpire from the anterior to the posterior tibial artery.

Fracture of the leg. There may be a fracture of either of the bones singly, or of both of them. Fracture may be oblique transverse or compound. Compound fracture cannot take place unless both of them be broken. Fracture of both is the most frequent accident, and compound fractures occur more often in the leg than in any other part of the body.

If there be only one bone broken, then the other is a natural splint to it, and there can be no displacement. Here rest and cold lotions are the chief means towards recovery. But in fracture of both bones are

required; 1st. An accurate apposition of the fractured ends; 2nd. The application of splints to prevent motion, and a right position to relax the muscles or to prevent their action; 3rd. Treatment, both topical and general, to subdue inflammatory symptoms, or heal wounds if the case be a compound fracture. The first is easily accomplished. To perform the second, most surgeons advise the bent position of the limb; for my own part, I prefer the straight, and have always used it. I can easily conceive, that when the ends of the muscles of the calf are approximated to each other, as in the bent position, there must be greater facility of action afforded them, and much more power too, which must operate upon the fractured end as upon a false joint, when there is any untoward disposition to spasm. Whereas if the foot at the anterior extremity of its arch, or, that is to say, towards the toes, be made a *fixed point*, there is a resistance to the action of the gastrochnemii by the foot as by a lever, there is considerably less power of motion, which, if exerted at all, would operate not upon the fracture but upon the knee joint which it could bend, and moreover there is a natural splint, made by the bellies of the muscles thus proportionately extended for the prevention of the starting of the fractured ends below.

The apparatus which has been used in accordance with this principle is exceedingly simple, it consists of an horizontal plane, with a *perpendicular* foot-board; the foot is made to assume a perpendicular position so as to extend the heel, and

is fixed to the extremity of the afore-mentioned perpendicular piece. The limb is also bound to the horizontal plane just above the knee, and two splints so applied as to give continued extension and prevent the displacement of the bones anteriorly and laterally, complete the whole. Of course, the usual furniture of pads, tow, a bandage, soap-plaster, etc. are necessary in this as in all other fractures of the limbs. However, in certain cases of oblique fracture, and in old subjects, the objections to the bent position are not so great. In this, a splint will be placed beneath, and two at the sides of the limb, accompanied with the usual pads and bandages. The external splint must have a circular hole to accommodate the malleolus externus.

PATELLA.

The patella constitutes the prominence of the knee joint. It is resembled to the figure of the heart on a playing card.

Its *base* is placed superiorly, and is rugged and sulcated where it receives the combined tendons of the rectus crureus and vasti.

Its lower point, called the *apex*, directs toward the tubercle of the tibia, to which it is attached by the ligamentum patellæ.

Its *anterior* surface is convex striated and rough, being covered by the continuation of the above-mentioned tendon, which is so closely affixed thereunto as to give origin to the opinion that this bone is without a periosteum.

The *posterior* surface is smooth, doubly concave,

and covered with articular cartilage. Its double concavity is adapted to the convexities of the two condyles; between them also there is an elevated ridge dividing them into two unequal surfaces, which ridge is opposed in like manner to the depression between the condyles.

The *circumference* of the patella is rugged for the attachment of the capsular ligament, and theca of the vasti muscles.

In the FŒTAL STATE the patella is wholly cartilaginous.

Observe, that though this is a spongy bone, yet the external tables are particularly dense, whereby it has the appearance, and indeed the possession of considerable solidity and strength. Its office is analogous to the olecranon of the elbow joint, and forms a powerful fulcrum to the rectus and vasti muscles in the extension of the leg. It is capable of motion laterally, and limited elevation and depression.

FRACTURES. The patella in consequence of its being an appendage to powerful muscles making extension of the leg, is liable to fracture not so much from a blow received in a fall, as would appear at first sight, but from the contraction of the extensor muscles in the act of falling, to prevent which they thus contract. When the patella is fractured by that means, the fissure is horizontal, and the portion appended to the muscle is drawn up, by its contraction, considerably above the joint, as far as its mucous fold will permit, and from its lower part which is retained in its proper

place by the ligamentum patellæ. Now the treatment of this is very simple. The indications are, to relax the muscles antagonizing, and to appose the fractured bones. For the former purpose, you would make the limb to form a considerable angle with the trunk, whereby the rectus (which is the principal) will have its origin approximated to its insertion: and the second may be affected by extending the leg and keeping the two parts together by a bandage: some even think that unnecessary. Now it will appear evident that the two greatest evils the surgeon has to cope with in a case of this nature, are inflammation of the surrounding structures, *i. e.* of the capsule of the joint, or more properly its synovial membrane; and of spasmodic contraction of the muscles, whereby displacement of the fracture may take place. In meeting these, the surgeon uses his lancet and topical depletion, aperients and antispasmodics, cold lotions and bandages. When the patella is fractured by a blow, it may make a longitudinal fissure: here there is scarcely any displacement, or if there be, it is merely sufficient to prove the nature of the accident, inasmuch as the ligament and tendons keep the fragments together as a natural bandage. Nothing better can be done, here, than enjoining rest in bed, with topical and general depletion as may be found necessary.

Dislocation of the patella may occur either *outward* on the external condyle; or *inward* upon the internal. The most frequent is the former kind, in consequence of the greater facility allowed for

the accident from the conformation of the condyle. The reduction is easy; the indications are to relax the rectus and vasti muscles and, reducing the dislocation, to keep the bone in its place by a bandage, which is sometimes a difficult task; thirdly, using all measures to prevent inflammation of the joint, which is apt to accrue; and lastly, to prevent stiffness of the joint after the accident by a cautious use of it subsequent to the period of a few days' rest.

THE KNEE JOINT.

The *osseous parietes* of the knee joint are, superiorly, the condyles of the os femoris; inferiorly, the fossæ condyloidei of the tibia; and anteriorly, the posterior surface of the patella.

The *soft appendices* of the knee joint are, the capsular ligament, the ligaments situated without this, and the ligaments within, the synovial structures, and the semilunar cartilages.

The *motion* of the knee joint is, angular ginglemus with a limited degree of rotation, when the leg is in a flexed position.

The *capsular ligament* is a thin expansion of synovial membrane, connected superiorly to the condyles of the femur, a considerable distance above the circumference of the articular cartilage, so that it is in fact, a reflection of a membrane which lines the sides of the condyles; and which is implanted thereon by processes of cellular substance which insinuate themselves into the numerous foraminulæ which are perceptible on the inarticular parts of the condyloid processes. Observe, that

the distance between the circumference of the articular cartilage and the immediate reflection of the capsule from the bone, is greatest at the *sides* of the condyloid processes, and that it diminishes anteriorly and posteriorly, so that the reflection is made almost immediately from the margin of the cartilage in both those latter parts of the joint. The capsular ligament is attached anteriorly to the circumference of the articular surface of the patella; hereby the patella is made to constitute a part of the capsule itself: and it is attached inferiorly to that rough surface surrounding the head of the tibia, which is situated excentrically to the articulated fossæ, and above the anterior tubercle and depression for the head of the fibula.

Having thus described the capsule, now proceed to a study of the parts situated without it. First of all, you see the patella, with the rectus, two vasti, and crureus, combining to become inserted into its base: from the lower part of the vasti, also a tendinous expansion is traced descending to become attached to the circumference of the patella, and to lose itself in the fascia of the leg, while it combines and strengthens the synovial capsule in its course. You next see descending from the apex patellæ, the combined tendons of the above-named muscles, the fibres of which have passed over that bone, with whose substance it has been in intimate connection; you see also that it there alters its tendinous into a ligamentous character, by becoming denser in structure, and having its fibres more approximated so as to be enabled

to descend in a collected form under the name of *ligamentum patellæ* to the anterior tubercle of the tibia, where it is implanted.

In the angular space behind the extremities of the rectus and vasti muscles, above the base of the patella, and in front of the union of the condyles, there is the *superior genual bursa mucosa;* which serves to defend the bone from the continued action of those muscles, and to give them liberty of motion: it is frequently found communicating with the interior of the joint. In the angular space behind the ligamentum patellæ, below the apex patellæ, and in front of the head of the tibia above the anterior tubercle, is situated the *inferior genual bursa mucosa:* it bears the same office to the ligament as the superior does to the tendon, and also frequently communicates with the joint.

On the external side of the joint are two ligaments. 1. The *ligamentum laterale externum longus* is a thick strong collected cord of ligamentous fibres, stretching downwards and forwards from the side of the external condyle to which it is attached superiorly, to the head of the fibula, on which it is implanted inferiorly.

2. The *ligamentum laterale externum brevius,* is attached superiorly to the same part of the condyle as the former, with which it is in close connection; whence it descends posteriorly, in an expanded form, so as to become implanted inferiorly into the upper and back part of the head of the tibia, behind the head of the fibula. By these two ligaments the exterior part of the capsule is strengthened and lateral motion prevented.

On the inner side of the joint there is only one broad and strong ligament. The *ligamentum laterale internum*, is attached superiorly to the upper part of the side of the internal condyle; and inferiorly, in an expanded form, to the superior and internal part of the head of the tibia: in its descent the ligament stretches obliquely forward from its superior attachment.

On the posterior surface of the joint are seen two ligaments. The *ligamentum posticum winslowi*, is found attached superiorly to the most prominent and posterior part of the external condyle, from which it descends obliquely across the posterior part of the capsular ligament; and is attached inferiorly to the internal and posterior part of the head of the tibia in a somewhat expanded form. It is parallel with the popliteus muscle, to which it is in intimate connection, and it gives origin to part of the gastrochnemus and plantaris muscles.

Ligamentum posticum cartilaginis internæ. This is a fasciculus of fibres attached, superiorly and externally, to the inner side of the external condyle; and, inferiorly and internally, to the semilunar cartilage on the inner side of the head of the tibia. This is in fact a medium between the lig. posticum of WINSLOW and the crucials.

Now make a section of the capsule and study the parts within the cavity of the joint.

Ligamentum mucosum. This is a fold of the synovial capsule, inflected from the anterior parietes of the joint into its cavity, towards the upper part of the anterior surface of the femur: it con-

tains synovial fat, which it serves to preserve in its place during motion, and also to distribute its secretion. The two *ligamenta alaria* are merely the lateral continuation of the former. They are connected to the sides of the patella, and gradually diminish so as to be ultimately lost in the smoothness of the continued capsule.

The *synovial mass* is situated under these and the ligamentum mucosum, and around the circumference of the patella: the action of which in extension and flexion of the leg causes the discharge of its secretion.

The *semilunar cartilages* are two in number, both of which are situated above the circumferences of the two fossæ condyloideæ of the head of the tibia. They are thin slips of cartilage; having each an external thick margin which is attached to the circumference of the articular surface of the head of the tibia by the capsular ligament; an internal thin acute falciform margin of a lunated appearance, which is opposed to the cavity of the joint, and around which the capsular ligament is reflected; an interior extremity or corner where it is diminished in size; and a posterior extremity or corner where the thickness of the cartilage has also waned into an acute termination.

There are *four ligaments* to the semilunar cartilages. These are the two *ligamenta antica, et postica lunitaria*, which are in fact, only four slips of ligamentous substance extending inwards from the extremities of the semilunar cartilages towards the tubercle on the centre of the upper surface of

the tibia to which they are attached. The office of the semilunar cartilages is to deepen the socket in the condyles.

We come lastly to the description of the two ligaments which mainly contribute to the strength of the joint. These are the *ligamenta cruciata*. The *ligamentum cruciatum anticum* is a strong series of ligamentous fibres, mingled with synovial fat, occupying the internal half of the hiatus condyloideus, or deep gap between the condyles, to which it is attached superiorly; and posteriorly it descends obliquely forwards, and is attached inferiorly and anteriorly to the rough depression immediately in front of the tubercle on the upper part of the tibia.

The *ligamentum cruciatum posticum* in like manner is attached superiorly and anteriorly to the external side of the hiatus, or, that is to say, to the inner side of the external condyle; thence it passes obliquely downwards, inwards, and backwards; and is implanted inferiorly into the rough depression behind the tubercle on the upper part of the head of the tibia, *and sends a distinct slip to be implanted on the back of the internal semilunar cartilage.* These ligaments are embedded in synovial fat, and are in appearance like detached cords of ligamentous substance running in these two decussating series. They prevent the extension of the leg to a greater degree than to attain a line with the thigh.

DISLOCATIONS AND DISEASES OF THE KNEE JOINT. One would imagine at a superficial view of the

osseous parietes of the joint, that from the shallowness of the sockets and the largeness of the condyles, this joint were a weak one; but when all the organs thereof are considered, and the ligaments so numerous and strong are taken into account, our second impression is that it could scarcely ever be injured; but experience teaches us that ligaments however strong may be lacerated, and this joint may be luxated. The tibia may be displaced either forwards, backwards, or to either side: of these four kinds the former is the most rare, the second is scarcely more frequent, and the lateral, though not so uncommon, are notwithstanding never complete. The character of the accident in either case, is so self-evident that it would be waste of time to describe it. In some of them, suffice it to say, however, that the crucial ligaments are not necessarily broken, in others the accident cannot occur without it, in the latter of which, of course, the dangerous symptoms likely to result must be more serious. The reduction also is almost as easily accomplished as the diagnosis, and shall not be dilated on here. Let us conclude with stating that in this joint, of all others, is to be dreaded the consecutive inflammation, therefore rigorous antiphlogistic measures must be used. The same judgment also is required in reference to the time allowed to the patient for confining his knee during the union of the ligaments, to accomplish which is usually allowed in the generality of cases three weeks; after which, a certain degree of motion should be prescribed daily, to prevent lameness.

HYDROPS ARTICULI OR HYDARTHRUS.

Hydrops articuli, by which is understood the collection of a fluid in the cavity of a synovial membrane, is of two kinds; *true*, or that of the capsular ligament, and *spurious*, or that which is contained in a bursa mucosa. Although all joints are liable to this disease, yet the knee joint is most commonly affected by it; and this arises no doubt from the liabilities of this joint to be affected by rheumatism, exposure to cold, and great exertion, in connection with the intricacy of its construction and the extent of its synovial surface. A lymphatic debilitated constitution, or the weakness resulting from febrile attacks, scrofulous affections, and local injuries, are among the causes, whether constitutional, predisposed, or exciting. Now the great object in the treatment is the reduction of the fluid, for which purpose counter-irritants, such as very large and repeated blisters, frictions, camphorated liniments, may be used: to which may be added, the application of a bandage with a moderate degree of pressure, the continued use of refrigerant lotions, electricity, etc. while at the same time the bowels are to be kept open with mercurial preparations. If the disease be the result of debility, then tonics are indicated.

WHITE SWELLING.

This disease is one of the most formidable which can attack an articulation. Writers who cannot be termed altogether ancient, have divided this disease into two kinds: one, where the soft parts are

diseased alone; the other, where the bones are the first seat of disease. But herein they err, inasmuch as white swelling is undoubtedly a disease of the soft structures of a joint. These authors were deceived by the apparent expansion of the articular extremities of the bones, which was a received opinion: but this is only the swelling of the soft structure upon their extremities, as the bones will be found of natural size after they have been denuded through maceration.

There are those also who divide the disease into two other kinds, viz. *rheumatic* and *scrofulous white swelling*. This class of writers is chiefly continental, under whose observation spurious species of articular disease resulting from, or partaking of, the nature of the former, frequently occur: whereas in England, the only disease liable to be mistaken for, or classed with, the true scrofulous white swelling, is the chronic enlargement of the knee joint; which however may be said to be analogous to the rheumatic affection, described by the continental surgeons. Suffice it to say, that if any classification of this disease and its varieties be used at all, it must be a very extensive one, and must, in fact, comprehend all the peculiarities of those cases, where the symptoms are diversified according not only to the constitution of the patients, whether lymphatic, scorbutic, or otherwise; but to the mode of developement of their affection. Now I think a detail of the symptoms may be considerably assisted by a systematic reference at the same time to these three divisions of the disease, which com-

prehend its *three stages ;* 1st. the affection of the synovial structure; 2d. the affection of the parts outside of the joints; and 3d. the ulterior disease of the bones.

In true scrofulous cases, with few if any exceptions, the first symptom is pain referred to the interior of the joint on both sides of the patella. Now if you turn to the description of the joint you will see that the organs on the posterior part of the capsule, and laterally to the patella, are the corpus mucosum or synovial mass, the ligamentum mucosum, and the lig. alaria : * consequently the pain indicates the beginning of the mischief in these parts, the cause of which is the accession of an inflammation of a peculiar character, which operates upon the synovial mass in such a way as to alter its secretion from the glaring or mucilaginous articular fluid, to a gelatinous lymph; in which are subsequently found flakes of coagulum of greater density, and after a longer period of time when ulceration is induced, a curdy or caseous matter, something similar to that which is found in other scrofulous sores. During this, the first stage of the disease, the knee is not seen to be much enlarged, unless it be that the depressions on either side of the patella, where the pain is referred, are not so evident in the affected as in the sound limb ; the only positive accompanying symp-

* Or if the pain be in the first instance referred to the centre of the joint at the superior tubercle of the tibia, here also we have the synovial structures in the substance of the crucial ligaments, which become the nidus of disease.

tom is the stiffness of the joint, which ensues, probably, as much from the cautious and partial use of the leg, as from the extent of the internal disease.

The second stage is marked by still severer symptoms: in addition to the pain and lameness, there are great and increasing swelling, attended by ulcerations and abscesses succeeding each other, and producing all their local and constitutional ill consequences. Here then, we have proof that at last the parts without the capsule have sympathized with the morbid affection within, the languid inflammatory action has passed into the cellular substance surrounding the joint; the same peculiar alteration of structure affects this, it becomes at once pulpy and thickened, just as parchment which has been boiled for a considerable length of time; the hitherto distinct layers become agglutinated, so as to give to the finger the feeling of a dense osseous substance, and not of a soft, pitting, anasarcous state; the skin stretches so that it cannot be puckered into wrinkles, and in proportion to the extension, glistens, but does not undergo any organic change. Finally, this altered cellular structure suffers also, like the synovial mass, a further derangement; abscesses and ulcerations take place, which partially heal, and are succeeded by others still larger and more sinuous; the constitution becomes alarmed, and hectic supervenes, the pulse is fitful and small, diarrhœa and profuse perspiration continually occur, producing extreme debility, loss of sleep, and impaired appetite. If the disease go on to the third stage, we have it setting up its action in the osseous structures; a soft-

ening of the bone takes place resulting in caries. Then, after an interval it may be that the hitherto cartilaginous coat of the condyles becomes a pulpy gelatinous investment, which amalgamates with the similar coat of the head of the tibia; organic union may succeed, and if art should assist nature, another and more healthy blush of inflammation takes place, accessions of which from time to time will deposit a nucleus of bone in this substance; the osseous secretion will go on, not only therein, but also in the substance of the bones, and anchylosis will become at once the effect and the cure. These results often take place notwithstanding that ulcerations and abscesses can be easily traced into the bones at the same time; these make the latest symptoms and the most tedious of cure, even after the anchylosis has been fully established.

But we have traced the disease to the happiest termination it experiences; for, after scrofulous suppuration has taken place in the cavity of the joint, it is incapable of further use, the patient has but three alternatives, to submit to amputation, to risk anchylosis, or death. The knife is generally used in the course of the second stage before the constitution is considerably affected.

Now two lines of treatment are distinctly indicated here; the one antiphlogistic measures where acute inflammation exists; the other counter-irritation as to topical remedies, while, tonics form the general regimen, where the case is entirely chronic. In the former, topical bleeding, whether "by leech or by lance," cold saturnine or evaporative lotions

and purgatives are necessary, but as soon as the inflammation is subdued, so soon must these remedies be set aside. Palliatives are a class of remedies not to be touched in this disease, and after the subsidence of inflammation, leeches and cold lotions are worse than palliations: something effective must be done, because the disease has gone into that other state, termed for sake of distinction, chronic, and therefore counter-irritation must be immediately carried into full operation, whether by repeated and large blistering, or the formation of issues. If the former be used, partial practice is of no good; the whole joint must be vesicated at once, and the cutaneous irritation be increased by savine ointment; if the latter be used, there is need of two or three escars being made and kept permanently open by the usual means; of the two, the former is decidedly the most convenient and effectual, inasmuch as the irritation is more universal, more easily excited, and is not in danger of becoming inert or indolent as the surface of an issue is. (Pressure by bandage may be found to avail; or the encircling the joint with strips of adhesive plaster rather tightly; rubbing the limb with the hand; astringent applications of oak-bark or mineral salts; each have been found useful and successful in rheumatic cases, and perhaps may in mild cases of true scrofulous white swelling.)

The state of the constitution is the great consideration which determines whether, after all, the limb shall be saved or be lost, and to this, which every surgeon will be mindful to prop by generous

diet and tonic regimen, will he anxiously and daily direct his attention : if he should see no accession of hectic or diarrhœa; no alteration of the pulse; no diminution of the animal capacities, appetite, or ability to sleep, then why should recourse be had to a painful and unnecessary operation? But if on the other hand, the swelling should increase and abscesses succeed each other, accompanied by accessions of inflammation, which compel the surgeon to lay aside the counter-irritation which he has practised; if the constitution should suffer, morbidly sympathizing, then why should the patient be permitted to go beyond the reach of art, when the knife would relieve him at once from the diseased source of his constitutional derangement, and the approaches of a premature death?

PES.

The foot is divided into the bones of the TARSUS, the METATARSUS, and PHALANGES. Each series being arranged in the articulated foot so as to form an elongated arch in the aggregate.

THE TARSUS.

This is composed of seven bones, irregular in form, and various in size, connected together by numerous joints, which comprise the fixed and immoveable, the yielding, the hinged, and the ball and socket kinds of articulations.

They are thus denominated; the astragalus, the most superior; the os calcis, the inferior and posterior; the os naviculare, anterior to the astragalus;

the three ossa cuneiformia, in front of the naviculare; and the os cuboïdes, externally to these, and situated in front of the calcis.

ASTRAGALUS. This bone forms the inferior part of the ankle joint, and consequently is in immediate apposition with the tibia and fibula.

It may be very properly divided into a HEAD, situated anteriorly; a NECK; and a BODY, which constitutes the inferior part of the above-named joint. For the sake of description, we will commence with the BODY first, and divide it into five surfaces. A superior, external, internal, inferior, and posterior.

The *superior* surface, or upper part of the body of the astragalus is entirely articular, semilunar, and convex in an antero-posterior direction, and concave in a transverse, whereby the margins of the superior surface, also articular, are elevated. Observe also the external margin obliquely approaches the internal, which is direct; so that they almost insensibly join in an angle posteriorly, whereby the anterior part of the trochlea is, of course, the broadest.

The *external* surface of the astragalus is also articular to a considerable extent, fringed only by a margin, rough and elevated, for the attachment of ligaments. It is inclined obliquely, is concavo-convex, and exactly fitted to the malleolus externus of the fibula, which is opposed to it.

The *internal* surface of the body is equally divided into an articular and an inarticular surface. The superior is the articular, which is nearly per-

pendicular and very narrow posteriorly; but oblique, a little hollowed, and much broader anteriorly; it has opposed to it the malleolus internus, which requires a smaller articulating surface than the external. The inferior part of the internal surface is rough and concavo-convex, pitted immediately below the articulation for the attachment of the capsular ligament; and elevated at its lowest part into half of a tubercle, completed by the os calcis, for the insertion of the internal ligament strengthening the ankle joint.

The *inferior surface* of the bone at large is threefold: the most anterior of which is the under articular surface of the head: the middle is the sinuosity, the continuation of the cervix or neck: the posterior is a concave semilunar articular cavity immediately below the body, and opposed to the superior part of the calcis. We will therefore describe the under surface completely, having thus made reference to the three parts contributing to it.

The *most anterior* division of the under surface of the bone, while it constitutes part of the oblong articular head of the astragalus, is distinguished from it by being flatter, as though the rotundity had been rasped off in two places, leaving a slight elevation in the middle. This double articular surface is received upon two others, corresponding to them, upon the os calcis.

The *middle* of the three inferior surfaces is a deep scabrous sinuosity, apparently a continuation of the neck of the bone. Commencing in a small deep channel on the inner side of the astragalus, it runs

forwards and outwards between the two inferior articulations, deepening as it continues, until it forms an extensive cavity on the exterior part of the side and under surface of the bone. This sinuosity is filled with a ligamentous apparatus which joins immovably the astragalus with the calcis.

The *posterior* division of the three inferior surfaces is a semilunar articulating concavity, placed diagonally, so that its direction is from the external malleolus inwards and backwards, that its termination may be behind the malleolus internus: thus it crosses the articulation of the upper surface of the body, which runs between the malleoli from before backward. This cavity receives a correspondently elevated articulating surface on the upper part of the os calcis.

The *posterior surface of the body* is, in point of fact, only a line of scabrous bone which gives attachment to the capsular ligament of the ankle joint.

The NECK is the rough, unequal foraminulated surface, forming the link of connection between the head anteriorly, and the body posteriorly. It is *ridged* on its outer surface, where it gives attachment to the anterior external lateral ligament; *narrow* on its internal, *flat* upon its upper, and *sinuous* upon its lower surface, where it forms the excavation before described.

The HEAD is an oblong articulating process, situated at the most anterior and internal part of the bone. The upper part of this articulation is found almost on a line with the centre of the articulation

on the upper surface of the body, from which it descends inwards and backwards, so as to give the bone a twisted form. It constitutes the ball of a joint very remarkable in its formation, and which will require in due time particular description.

This bone is semiossified in the fœtus.

THE ANKLE JOINT.

The bones and their parts entering into the formation of the ankle joint are, *superiorly* the scaphoid cavity of the tibia; *laterally* the malleoli externus of the fibula, and internus of the tibia; and *inferiorly* the upper and lateral surfaces of the body of the astragalus.

Ligamentum capsulare. This is very thin and loose; it is connected superiorly to the circumference of the greater scaphoid cavity, the lesser scaphoid cavity, and the malleolus internus of the tibia,; and malleolus externus of the fibula: and inferiorly to the circumference of the three articulating surfaces of the upper part of the body of the astragalus.

The ligaments on the *external* side of the joints are three; viz.

Ligamentum laterale externum anticum, which is attached superiorly and posteriorly to the anterior part of the malleolus externus, and descends to be attached inferiorly and anteriorly to a ridge upon the side of the neck of the astragalus.

Ligamentum laterale externum medium, seu perpendiculare fibulæ descends from the malleolus externus, whereto it is attached superiorly to a

tubercle on the outer side of the body of the os calcis inferiorly this ligament is very strong and glistening.

Ligamentum laterale externum posticum is attached superiorly and anteriorly to the inferior and posterior part of the malleolus externus; passes downwards and backwards; and becomes implanted on the inferior and posterior part of the external surface of the astragalus. These three ligaments while they are distinct fasciculi, are at the same time made continuous by intervening ligamentous connections, whereby an external fan-shaped expansion is formed, having the centre fixed to the malleolus externus, and the radiation upon the anterior and posterior parts of the astragalus, and the side of the os calcis.

There is but one ligament upon the *inner* side of the joint; viz.

The *ligamentum deltoides*. This ligament is attached superiorly to the malleolus internus; in the form of a centre of convergeance of less distinct fasciculi of ligamentous substance than those which constitute the external ligaments of the joint; from which point of convergence its fibres radiate, forming a fan-shaped ligament somewhat similar to the Greek letter Δ, from which it takes its name; and are implanted anteriorly and inferiorly into the inner side of the os naviculare, directly inferiorly into the os calcis, and posteriorly and inferiorly into the lower part of the internal surface of the astragalus.

To these ligaments may be appended a descrip-

tion of those fasciculi which bind the extremity of the fibula to the lesser scaphoid cavity of the tibia. These are the *ligamenta transversaria antica et postica*, which are attached, internally, to the anterior and posterior surfaces of the extremity of the tibia, and externally, to the correspondent anterior and posterior surfaces of the upper part of the malleolus externus, whereby the fibula is rendered immoveably fixed to the extremity of the tibia. The *capsular ligament* is a process of the capsule of the ankle joint.

The bones and ligaments of the ankle joint form into a ginglemus connection, permitting extensive hinge-like motion, and a limited rotatory or lateral motion, and that only when in a state of extension, because the posterior part of the articular surface on the head of the astragalus is considerably narrower than the anterior.

OS CALCIS.

This is the largest of the tarsal bones, and is situated beneath the astragalus. It constitutes the prominence of the heel.

It is divided, for the sake of description, into two parts: the body and tuberosity.

The BODY constitutes nearly the two anterior thirds of the bone. It has five surfaces thus described.—Its *superior surface* is divided into four lesser surfaces, three of which are articular. The most *anterior* is a small oval plane at its internal part, and upon a process of bone which seems eked out on purpose; it looks obliquely upwards

and backwards, and is articulated to a flattened surface upon the oval head of the astragalus. The *middle articular surface* is exactly similar in size to the former ; is also situated upon a prominence, and a much larger process of bone ; looks upwards and forwards ; and is articulated to a flattened surface on the oval head of the astragalus. There is a scabrous separation between these and the *third* or posterior articular surface, which is very extensive in size; is convex in an antero-posterior direction and slightly depressed in a lateral; is situated obliquely ; and is fitted to the semilunar concavity in the under surface of the body of the astragalus. The *fourth* surface is not articular, but consists of a deep scabrous cavity, sulcating, at its commencement, the inner and most elevated part of the superior surface, between the middle and posterior articulating surfaces before described ; and extending thencefrom downwards and outwards, widening as it approaches the external side of the bone ; and thereby corresponding to the similar concavity described as sulcating the under surface of the astragalus, which bone forms it into a foramen in the macerated state, but which is filled up in the recent subject by several series of ligamentous fibres termed apparatus ligamentosus.

The *under surface* is irregularly concavo-convex, and with the inferior part of the tuberosity gives origin to numerous muscles. These are as follow: most posteriorly the tuberosity gives attachment to the plantar fascia ; immediately anteriorly to this arise (the first layer of muscles in the sole) the ab-

ductor pollicis, flexor brevis pollicis, and abductor minimi digiti; more anteriorly, arise the flexor brevis digitorum, flexor accessorius, and flexor brevis pollicis; and most anteriorly, from a cavity on the most anterior part of the under surface, the adductor pollicis.

The *external surface* of the calcis is somewhat perpendicular, having however two tubercles or elevations thereon. The most prominent is situated about its middle, and gives attachment to the ligamentum perpendiculare of the ankle joint, and origin to the extensor brevis digitorum, which also occupies the external surface of the body of the calcis anteriorly to this tubercle. The other is situated more posteriorly and inferiorly, and gives origin to part of the flexor accessorius. Some part of the external surface is situated below the malleolus externus, consequently we have crossing it at this part the tendons of the peronei, longus et brevis, beneath the ligamentum tarsi annulare posticum externum.

The *internal surface* of the body is a concavity of great extent, and is therefore called the *sinuosity of the os calcis*. This sinuosity is bounded superiorly by the two tubercles which have articular surfaces for the astragalus; posteriorly by the tuberosity of the heel; externally by the ligamentum tarsi annulare posticum internum, and inferiorly it is continuous with the sole of the foot. Its *contents* are all the tendons which pass behind the malleolus internus, and beneath the ligamentum tarsi annulare posticum internum, viz. the tibialis

posticus, flexor longus digitorum, and flexor longus pollicis. Observe the *tubercle* forming on its upper surface the middle articulation before mentioned: it gives attachment to a remarkable ligament.

The *anterior surface* is wholly articular, and is concavo-convex. To it is connected the os cuboïdes. The upper and inner part overhangs the lower a little, being a part of the anterior tubercle: which was described as contributing to the formation of the anterior or first of the three articulating surfaces on the superior side of the body.

The TUBEROSITY is eked out of the *posterior part of the body*, which, seen from behind, is somewhat conical, with the base downwards: it is composed of two surfaces, the superior of which is smooth, being covered by a bursa mucosa, which intervenes between the tuberosity and the tendo achillis. The inferior is rough, and thereon are implanted the tendo achillis and plantaris. The tuberosity also appears most prominent on the lateral and internal aspect of the bone, where it forms the posterior boundary to the sinuosity, and gives attachment to the posterior part of the ligamentum tarsi annulare posticum internum. On the '*solar aspect*' it is also prominent, to give attachment to the fascia plantaris, and to complete the posterior part of the arch of the foot.

In the fœtus this bone is considerably ossified; the cartilaginous tuberosity forms subsequently an epiphysis.

OS NAVICULARE.

This bone is situated immediately in front of the

astragalus. Its shape is navicular, as its name implies. We will describe it as having six surfaces, two of which are articular.

The *superior* surface is rough, convex, and oblique, and constitutes part of the dorsum of the foot; it is crossed by the tendon of the extensor longus pollicis, and the dorsal continuation of the arteria tibialis antica.

The *inferior* surface is rough and concave, and looks downwards and inwards, constituting a part of the sole. It gives origin to parts of the abductor pollicis, and attachment to ligaments.

The *anterior* surface is convex and articular, presenting three oblique planes for the apposition of the three cuneiform bones.

The *posterior* surface is articular and concave, receiving the head of the astragalus.

The *external* surface is narrow and inarticular, being opposed to the os cuboides.

The *internal* surface is broader than the external, and is inarticular, terminating in a prominent *tubercle.* This tubercle, then, situated at the inner and inferior part of the bone, is very important. It gives attachment to a ligament which completes the socket for the head of the astragalus, to other ligaments also, and insertion to the tendon of the tibialis posticus.

OS CUBOÏDES.

This bone is situated in front of the os calcis, on the outer side of the foot. It has six surfaces, three of which are articular.

The *superior* surface is rough and scabrous, constituting a part of the dorsum of the foot; it gives origin to part of the extensor brevis digitorum.

The *inferior* surface is broad, inarticular, and divided into two parts by a prominent eminence of bone. Anteriorly to this there is a groove or sulcus stretching obliquely across, which is occupied by the tendon of the peroneus longus. Posteriorly the bone is occupied by the implantation of ligaments. The prominence gives origin to the flexor brevis minimi digiti and abductor pollicis.

The *posterior* surface is articular and waved, or concavo-convex, being adapted to the articulation on the anterior part of the os calcis.

The *anterior* surface is somewhat oblique, so as to look a little outwards also; it has two surfaces, one for the base of the metatarsal bone of the third, and the other for part of the base of the metatarsal bone of the little toe.

The *external* surface is a deep notch, scabrous and inarticular, giving origin to the flexor brevis minimi digiti.

The *internal* surface is oblique broad, partly articular and partly scabrous. It is divided into three smaller surfaces; the two anterior of which are opposed to the external surface of the external cuneiform bone, the former is scabrous, the latter is articular: the posterior surface is inarticular, and is opposed to the os naviculare.

OSSA CUNEIFORMIA.

These are three in number, situated immediately

in front of the os naviculare, at the inner and fore part of the tarsus. They are wedge shape, and are denominated internum, medium, and externum.

Os cuneiforme internum. This is the largest of the three, and is situated with its base inferiorly and apex superiorly. Its *base* is the under flat inarticular surface, opposed to the sole, giving attachment to strong ligaments, origin to the abductor pollicis, and insertion to the tibialis posticus and peroneus longus. The *apex* constitutes, as before said, a part of the dorsum, where it is crossed by the tendon of the extensor proprius pollicis.

The *internal* surface is inarticular, and gives insertion to the tibialis anticus.

The *external* surface is opposed to, and articulated with, the side of the base of the metatarsal bone of the second toe, and inner side of the os cuneiforme medium.

The *anterior* is an articular surface, opposed to the base of the metatarsal bone of the great toe.

The *posterior* surface is articulated with the inner oblique plane on the anterior surface of the naviculare.

Os cuneiforme medium, or minimum; because it is the smallest, is situated externally to the latter bone. Its base is upwards, constituting a part of the dorsum. Its apex therefore is in the sole, where it gives origin to the flexor brevis pollicis.

Its *anterior* surface is articulated with the base of the metatarsal bone of the second toe: its posterior with the middle oblique plane of the os naviculare: its internal with the os cuneiforme inter-

num : and its external with the external cuneiform bone.

Os CUNEIFORME EXTERNUM, situated in front of the os naviculare, and between the middle cuneiform and cuboïd bone. It presents its base on the dorsum, and its apex in the sole. Its anterior surface is opposed to the metatarsal bone of the third toe ; its posterior surface to the os naviculare ; its internal surface to the os cuneiforme medium, and side of the base of the metatarsal bone of the second toe ; and its external surface to the os cuboïdes.

METATARSUS.

This is a range of five bones, situated in front of the tarsus ; forming an irregular arch in a lateral direction, the highest part of which is found to be on the dorsum, between the shafts of the great and second toe.

Each individual bone, (and consequently the whole series also) is found to form half of an arch in an antero-posterior direction ; the most elevated points of which are, the bases of the bones, or where they join the tarsus ; which latter series perfects the arch posteriorly, making the architraves the tuberosity of the os calcis behind, and the heads of the metatarsal bones in front.

There is a resemblance between the metatarsal and metacarpal bones, both possessing the general characters ; altered however, to meet the necessities of and adapt themselves to their different situations. Some distinguishing characteristics of the metatarsal bones are, their being large, slender

at their necks, and thick at their bases; whereas the metacarpals are less in length, broader at their heads and necks, and narrower near their bases: finally, the metacarpals have a ridge on their palmar surfaces, and the metatarsals a plane on their plantar aspects.

PROCESSES OF A METATARSAL BONE. Each is divided into a base, shaft, and head.

The *base* is an irregular thick quadrangular process, having generally three articular and two inarticular surfaces. Looked at upon the dorsum, it appears most square; in the sole it presents an angular or tuberculated process; which gives attachment to ligaments and muscles. The posterior surface is arthrodial where it is in apposition with the tarsus. The lateral surfaces are concavo-convex, where it is opposed to its fellow.

The *shaft* is the long triangular continuation of the bone, which gradually narrows as it proceeds forwards from the base; it possesses three surfaces and three ridges. The superior ridge is seen on the dorsum. The external and internal ridges are between the bones. The surfaces are an external and internal surface, occupied by the interossei externi et interni muscles: and an inferior or plantar surface, opposed to the sole, across which the transversalis pedis courses.

The *head* is an oblong process, having an oval articular convexity for the formation of the joint with the phalanges; and a circular ridge around it, very well defined, called (anatomically) the *neck*, for the attachment of the capsular ligament

there; more posteriorly, two tubercles, seen on the dorsal aspect, for the insertion of the interossei muscles, and attachment of ligaments; and lastly, more posteriorly still, the surgical neck, which is the narrowed connection between the head and the shaft.

PECULIARITIES OF THE INDIVIDUAL METATARSAL BONES. Observe, that from within outwards, the bones so arrange themselves as to turn obliquely, whereby the relationship of the superior spine, and external and internal surfaces of the shaft are altered with respect to the dorsum and sole: the superior margin or spine becomes internal, the external surface becomes superior, and the head, instead of being perpendicular, is more correspondingly oblique: the most direct bone consequently must be that of the great toe, the most oblique that of the little toe.

The metatarsal bone of the *great* toe is the thickest, most circular, and shortest. Its base is somewhat oval, and bears a resemblance to the os cuneiforme internum, by having its base downwards and apex on the dorsum. The articulation between this and the internal cuneiform bone, admits of little motion. The base gives insertion to the tendon of the peroneus longus, and tibialis anticus. Along the upper surface of the shaft courses the tendon of the extensor proprius, along its under, the abductor, tendon of the flexor longus, and flexor brevis, pollicis. The transversalis pedis is inserted into the anteriormost part of the shaft. The head is very large and oval,

possesses a great articular surface, and a sharp ridge for the capsular ligament; two articular surfaces or raised tubercles beneath, for the attachment of two subordinate bones, termed sessamoid; and a groove between, occupied by the tendon of the flexor longus pollicis. The ossa sessamoidea, vel subrotunda, are resembled to split peas; their office is to give insertion to muscles, and by being raised above the shaft, thereby to grant them greater powers. The subrotundum internum gives insertion to the abductor pollicis and part of the flexor brevis pollicis: the externum to the other part of the flexor brevis, adductor pollicis, and transversalis pedis.

The metatarsal bone of the *second* toe is the longest and most slender, the best model of the series. It is articulated posteriorly, at its base, with the os cuneiforme medium and externum, and gives origin to part of the abductor pollicis.

That of the *third* toe is next longest, is situated more obliquely, and is articulated at its base with the os cuneiforme externum. A prominence of this bone in the sole gives attachment to the extreme part of the tibialis posticus.

The metatarsal bone of the *fourth* toe, is still more oblique, and at its base is square, and articulated with the os cuboïdes posteriorly. Internally it has a tuberculated projection articulated with the third toe; and externally a concavity, receiving the side of the base of the fifth toe.

The metatarsal bone of the *fifth* is the shortest and most oblique; having its external and internal margins (instead of surfaces), and its superior and

inferior flat surfaces. Its base is elongated into a tubercle, eminently distinguishing this from the other bones: it gives insertion to the tendon of the peronei, brevis et tertius, and part of the flexor brevis minimi digiti, and insertion to the abductor minimi digiti. The oblique articular surface on the base, is opposed to the os cuboïdes. The under part of the shaft is covered by the flexor brevis minimi digiti.

In the fœtus, these, like the cylindrical bones, possess three portions, the ossified shaft, and the extremities cartilaginous, which soon become epiphyses.

PHALANGES.

These are series of bones ranging in front of the metatarsus, fourteen in number; moveable; constituting the prehensile appendages of the foot. These bones have a general resemblance to the phalanges of the hand, but are neither so long, nor do they possess such a correspondence between their extremities as the latter, because their prehensile powers are necessarily inferior by reason of their situation and office.

PROCESSES OF AN INDIVIDUAL BONE. There are three distinguishing parts,—the shaft and two extremities. The latter parts are the thickest; the posterior, or *base*, possessing a concave articular surface for the head of the metatarsal bone, or of the bone of the series posterior: and two inferior tubercles for the insertion of slips of the flexor tendons; the anterior or *head* possessing a trochlea, forming part of a joint, with the bone in front. The shaft is convex upon the dorsum, giving attachment to the

extensor tendons; and concave upon the plantar aspect, being covered by the continuations of the flexor tendons.

PECULIARITIES OF THE INDIVIDUAL BONES. The phalanges of the great toe are two in number: they are the largest and thickest. The first bone answers to the general description. The second bone terminates in a tuberculous inarticular projection, which gives insertion to the flexor longus pollicis. It has also two projections at its base, which gives insertion to the tendons of the flexor brevis, and extensor proprius pollicis.

The phalanges of the other toes decrease from the second to the fifth. The bones of the second row or phalanx, are one half the length of the first; and possess greater proportion between their shafts and extremities; the third row terminates in a series of tubercles similar to that described as belonging to the second bone of the great toe. On these bones at their extremities are inserted the flexor tendons, and on their superior convexities the extensor tendons: but recollect that the little toe has no tendon inserted on it from the extensor brevis pollicis.

The formation of OSSA SESSAMOIDEA is for the purpose of affording greater power to the muscles implanted on them. They may be found frequently at the bases of the phalanges, are usually in pairs, and are always to be seen on the head of the metatarsal bone of the great toe, and frequently in the tendon of the peroneus longus in the groove of the os cuboïdes; wherever they are they serve the same office as the patella.

LIGAMENTS AND CONNECTIONS OF THE BONES OF THE FOOT.

These shall be treated of under four classes, viz. 1. Those of the tarsus. 2. Those between the tarsus and metatarsus. 3. Those between the metatarsus and phalanges. 4. Those between the three phalanges of the toes.

LIGAMENTS OF THE TARSUS. Every articulation of the bones of the tarsus possesses a capsular ligament; which is a thin synovial membrane, dependent upon auxiliary ligaments for the strength of the joints.

Between the *astragalus and os calcis* the chief bond of union is the *apparatus ligamentosus* or *interosseous* ligament. This is two series of decussating ligamentous fibres filling up the sinus or foramen seen between these two bones; the greater number of fibres is at the external and superior part of the cavity, where also is found synovial fat.

Between the *astragalus and os naviculare*, which is a ball and socket joint, are found important ligaments: the socket of the os naviculare is incomplete at its inferior part, which is rendered perfect by,

The *ligamentum laterale internum* or *calcaneo-scaphoïdeum inferius* MECKELI, one of the most remarkable and important in the sole: it is attached posteriorly, to a tubercle on the inner and superior part of the os calcis above the sinuosity; and passes forward, forming a thick and somewhat triangular continuation, which supports the under side of the head of the astragalus, being covered above by

synovial or capsular membrane, and constituting a part of the joint; and is ultimately riveted anteriorly, upon the tubercle of the os naviculare.

This ligament is remarkable for its structure and office, being semicartilaginous and *elastic*, and thereby permitting a springiness or yielding to this joint, so that the effects of a shock in leaping are considerably diminished.

The *ligamentum dorsale latum* or *astragalo-scaphoïdeum*, is a broad plexus of fibres; attached, posteriorly, to the scabrous neck of the astragalus; and spreading over the joint at its upper side is lost, anteriorly, in the similar ligaments which strengthen the other joints on the back of the foot.

Between the os calcis, os cuboïdes, and other bones, beside the capsular ligaments, are,

The *ligamentum laterale externum*. This, so called in contradistinction from the internum, is different in its structure, being wholly ligamentous and shorter; it is attached posteriorly, to a tubercle upon the inferior and anterior part of the os calcis; it proceeds forward and outward, spreading; and is implanted upon the outer side of the plantar eminence of the os cuboïdes. From this a slip proceeds still more outwardly and forward to the tuberosity of the metatarsal bone of the little toe.

Ligamentum longum calcis, or *longum plantæ; et rhomboideum*, or *calcaneo-cuboïdeum inferius*, proceed from the same tubercle: the first superficially and directly, to become inserted into the eminence on the os cuboïdes, and the bases of the metatarsal bones of the third and fourth toes: the other deep-

seated, lying close to the bone, is rhomboid, and attached anteriorly to the tubercle on the under surface of the os cuboïdes.

Ligamentum superius, or *calcaneo-cuboïdeum superius*, is a dorsal plexus attaching the calcis and cuboïdes together, and strengthening the capsule above.

Between the other bones of the tarsus are to be found, beside the capsular,

The *ligamenta plantaria*, vel *inferiora transversaria*, fascicles of ligamentous substance, binding the navicular, cuboïd, and cuneiform bones together: these run chiefly transversely.

The *ligamentum laterale superius*, is the most anterior part of the apparatus ligamentosus; or that between the opposing sides of the os cuboïdes and naviculare on the dorsum of the foot.

The *ligamenta dorsalia*, are promiscuous bundles of fibres strengthening the joints on the arch.

LIGAMENTS BETWEEN THE TARSUS AND METATARSUS. Beside the *capsular*, (which are *posterior* and *lateral*) are the dorsalia, sets of fibres attached posteriorly to the upper scabrous surfaces of the cuneiform and cuboid bones, and anteriorly to the bases of the metatarsal bones.

The *lig. plantaria* are corresponding bundles attached, posteriorly, to the base of the internal cuneiform, and apices of the middle and external cuneiform, and under surface of the os cuboïdes; and anteriorly to the under sides of the bases of the metatarsal bones.

The *ligamenta transversaria postica* are sets of

fibres which traverse the under sides of the bases of the metatarsal bones, being successively implanted upon the tubercles seen on their plantar aspect.

The *ligamenta transversa dorsalia* are corresponding sets of fibres, stretching across the upper surface of the bases of the metatarsal bones a little more anteriorly (as the latter) than the joints themselves.

LIGAMENTS OF THE ANTERIOR EXTREMITIES OF THE METATARSAL BONES. *Capsular ligaments* attached posteriorly to the circumferences of the heads of the metatarsal bones; and anteriorly to the circumferences of the bases of the phalanges.

Ligamenta lateralia, externa et interna, strengthening the sides of the capsules, and passing from the tubercles, near the heads of the metatarsal bones, to the tubercles on the bases of the phalanges.

Ligamenta transversaria antica, are sets of fibres passing along the anterior extremities of the metatarsal bones, in opposition to the postica just mentioned; they have the same office of binding these bones together.

The ossa sessamoidea have *capsular ligaments*.

LIGAMENTS OF THE PHALANGES. These are, *capsular*, which inclose the joints; and *lateral*, which strengthen them. Beside these, there are thecæ on the under sides of the shafts of the phalanges, for the tendons of the flexor muscles.

ACCIDENTS OF THE FOOT.

Dislocations of the ankle joint are of four kinds,

whether complete or incomplete, viz. forwards, backwards, or to either side: in the two former, the extremity of the tibia is carried before or behind the astragalus: in the latter, the foot is either inverted or everted: and the great distinction in case of dislocation inwards, is the accompanying fracture of the fibula, which is an invariable accident.

Fracture of the fibula results from the resistance afforded by the malleolus externus, which barrier to dislocation must give way before that accident can take place. Whereas, in dislocation of the foot outwards, there is no necessity for fracture of the inner malleolus, it being less in size than the outer, permitting the head of the astragalus to pass it.

A complete dislocation may happen inwards, outwards, or backwards; but cannot forwards, owing to the formation of the malleolus externus, which must in this case be fractured, when it may easily take place without laceration of the ligaments lateral to the joint. Dislocation of the tibia forwards is difficult of reduction, by reason of the resistance of the extensor muscles. These must be relaxed and the foot pushed forwards, by making a lever of the heel, having made, of course, the extremity of the tibia a fixed point. After the reduction the injured foot must be sustained at right angles, with the leg, by a pad and bandage, and rest must be enjoined.

A dislocation to either side is easy of reduction, and reference must be made to the fractured fibula in that inwards, during the after treatment.

Dislocation of the astragalus is a serious accident, and one difficult of reduction. It is generally car-

ried forwards upon the os naviculare, so that the extremity of the tibia is opposed to the body of the os calcis. Here, then, one would imagine, that as most of the ligaments uniting the astragalus and calcis together, were ruptured, it would be an easy thing to replace the former bone by mechanical pressure from before backwards; but in too many instances this has been found so wedged between the end of the tibia the calcis and the naviculare, as to render replacement an impossibility. The consequence has occasionally been that the pressure in the soft parts, and other concurrent causes, have produced sloughing, and the necessity for subsequent amputation. In a case narrated by Dupuytren, an incision was made upon the bone, and attempts made to extract it, which, after great difficulty, were successful.

Dislocation may happen to the joint betwixt the anterior parts of the calcis and astragalus, and the os cuboïdes and naviculare. Now here the ligamentum laterale internum must be lacerated, and that, too, by great force; for this is an elastic substance. The os cuneiforme internum may also be luxated by a fall from a great height. These are accidents not easily remedied: the bones are seldom apposed, and it requires great art and constant quietude to keep the parts in any thing like coaptation, or to render recovery as complete as possible: yet how can it be, but that lameness should invariably follow a destruction of the elastic ligament just mentioned, or a breach in the arch of the

foot? The phalanges may be dislocated, but these are easily reduced.

Fracture of the metatarsal bones, or of the phalanges, is an occasional accident, produced by very heavy bodies falling upon them, (or, as I have seen it happen, when a cask gets loose on deck, in a rough sea), which so destroys them, and lacerates the soft parts, as indeed to render amputation the only chance of success.

CHAPTER V.

SECTION I.

THE SUPERIOR EXTREMITY.

THE superior extremities in the human subject constitute the chief prehensile agents: which are divided into numerous parts to afford greater extent of motion and increased power. The attachments of these organs to the trunk are very moveable, and are rendered chiefly by intervention of soft structures, more than by means of joints. It is only in the human race, in those animals which use their anterior extremities as prehensile agents, and in birds, where a clavicle is to be found; and comparative anatomy teaches us that even among these, the link is often imperfect, or modified very considerably, so as to obtain a different office.

The superior extremity possesses a clavicle, scapula, humerus, radius, ulna, carpus, metacarpus, and phalanges.

CLAVICLE.

The clavicle, the medium of connection between the superior extremity and the skeleton, is situated transversely at the anterior part of the root of the neck.

It is divided into two portions, termed the sternal and scapular, from the relations they bear to these two bones.

The *sternal extremity* is the inner half of the bone, which is bent convexly forward, presents a round smooth anterior surface; and a curved and flattened posterior, against which lies the subclavian vein.

The inner part of the sternal extremity is large and triangular: presenting an articular oblique surface, which forms, with an interarticular cartilage and ligaments, a joint between this and the first bone of the sternum. On the posterior part of the sternal extremity near its end, is seen a *tubercle* for the attachment of the ligamentum interclaviculare, and another inferiorly for the ligamentum rhomboideum. Also a flat surface superiorly for the origin of the sterno-cleido-mastoideus; a *point* posteriorly for the origin of the sterno-hyoideus; a flat surface anteriorly and inferiorly for the origin of the pectoralis major; and a line inferiorly for the insertion of the subclavius.

The *scapular* or *outer extremity* presents a reversed form, being concave anteriorly, convex posteriorly, and flat above and below. Its termination is waved, and broad; and possesses a little articular surface for its connection with the scapula. Observe a *tubercle* posteriorly to this connection, for the implantation of the ligamentum conoideum; and remark that the anterior edge of this portion gives origin to the deltoid, the posterior edge insertion to the trapezius, and the under side to the subclavius.

In the fœtus this bone is perfect.

Observe that this bone is of the shape of an italic *f*, or if you substitute an *f*, the stroke across the

middle will separate the two portions. It receives its name from the Latin word clavis.

CONNECTION OF THE STERNAL EXTREMITY OF THE CLAVICLE. The articulating surfaces are, that of the clavicle, the interarticular cartilage, and the cavity on the upper bone of the sternum.

LIGAMENTS. A *double capsular*, engaging the circumferences of the articulating surfaces, and the interarticular cartilage.

The interarticular cartilage is thick, and exactly moulded to the forms of the end of the clavicle and sternal articulation, and makes this a double joint.

Ligamenta radiata, are fibres attached to the extremity of the clavicle, and passing in a divergence over the capsule and interarticular cartilage.

Ligamentum interclaviculare posticum, passes from the point on the posterior part of the sternal end of the clavicle in a double form behind the joint: the superior set of strong fibres go to the clavicle of the opposite side; the inferior are implanted on the back of the first bone of the sternum.

The *ligamentum rhomboideum* is attached superiorly to the tubercle on the under side of this end of the clavicle, and passes directly downwards to the cartilage of the first rib.

The joint of the other end will be treated of in connection with the scapula.

DISLOCATION OF THE STERNAL END. This rare accident may take place in any direction but downwards; that forward is the most usual, there being less resistance than in other directions. When it occurs the accident is easily discerned: the

shoulder and arm must be made a lever, it is easily reduced but with difficulty retained; by the same apparatus as in a case of fracture.

FRACTURE. This accident is frequent, because the bone is slender and very moveable; and it occurs to a much greater extent than dislocation, and usually affects the middle portion.

In the treatment of both fractured and dislocated clavicles, a large wedge-like pad must be put under the armpit, so as to make extension, and the arm must be bound to the side underneath by a bandage, carried round the body; in a dislocation a compress upon the joint, and a crucial bandage is proper.

The figure of 8 bandage, exceedingly inadequate for its purpose, is in too common use.

SCAPULA.

This is a triangular bone, situated upon the upper and posterior side of the thorax, in opposition to the first six ribs, between which, however, and this, there is a thickness of muscle.

The body of the bone being triangular, may be said of course to possess

THREE ANGLES. 1. The *anterior angle* is the thickest part of the bone, and constitutes that which is analogous to the head, it possesses an oval articular cavity, termed *glenoid* from its shallowness, which receives the head of the humerus. The medium of connection of this to the body of the bone is the *neck*.

2. The *superior angle* is that which presents

upwards and outwards from the upper part of the bone: it gives insertion to the levator scapulæ.

3. The *inferior angle* is acute, and presents downwards and backwards, here the bone is crossed by the latissimus dorsi.

THREE MARGINS. 1. The *anterior margin*, between the superior and anterior angles, presents upwards and forwards, and is sharp.

2. The *inferior margin*, between the anterior and inferior angles, presents downwards and forwards, and is rough: and it gives origin to part of the teres major and teres minor muscles.

3. The *posterior margin* or *base*, presents backwards, and is the longest, giving insertion to the rhomboideus and serratus major anticus.

THREE PROCESSES. 1. *Spinous process*, which arises upon the upper part of the back of the bone, and, enlarging, divides that into two surfaces; it gives insertion to the trapezius, and origin to the deltoid muscle.

2. The *acromion* is the enlarged continuation of the spinous process, bending, so as to cover the glenoid cavity, and protect the upper part of the shoulder joint: it is flat above and below; articulated with the scapular end of the clavicle; gives insertion to the trapezius; and origin to the deltoid.

3. The *coracoid process*, so called from its resemblance to a crow's beak, projects from the inner side of the root of the neck; it is curved outwards, and gives origin to the omo-hyoideus, coraco-brachialis, and short head of the biceps.

THREE FOSSÆ. 1. *Fossa supra-spinata*, that part

of the dorsum of the bone above the spinous process. It gives origin to the supra-spinatus muscle.

2. The *f. infra-spinata*, is that part of the dorsum below the spinous process; it gives origin to the infra-spinatus, and teres-major muscles.

3. *Fossa subscapularis* or *venter*, the inner concavity of the bone, giving origin to the subscapularis muscle.

THREE NOTCHES. 1. The *acromion notch*, is the largest, being situated under the acromion process: it gives passage to the tendon of the supra-spinatus.

2. The *coracoid notch* is situated under the coracoid process: it gives passage to the tendon of the subscapularis.

3. The *semilunar notch* is situated in the superior or anterior margin, and is occupied with the continuation of the supra-scapulary artery and nerve.

FŒTAL STATE. The base, acromion, coracoid, and head, are cartilaginous; the former soon become epiphyses, the head an apophysis.

OBSERVATION. The continued action of the muscles prevent the thickening of the body of the bone; in after-life it gets almost transparent by reason of the change which the osseous system universally undergoes.

CONNECTIONS. The connections of the scapula with the trunk are wholly by means of soft structure, and with the clavicle by a capsule, and strong superior and inferior ligaments; also the

Ligamentum conoideum is attached superiorly to a tubercle upon the external side of the clavicle, and

descending is affixed to the coracoid process of the scapula.

The *ligamentum trapezoideum* extends from the extremity of the coracoid process of the scapula in an expanding form, to the under edge of the clavicle. These ligaments are so very strong that no motion is permitted between the bones.

LIGAMENTS PROPER TO THE SCAPULA. *Ligamentum proprium triangulare scapulæ* is attached in a narrowed collected form to the posterior edge of the acromion process; widens, becoming thick at its edges, and thinner in the centre, and is implanted broad and triangular upon the external side of the coracoid process.

Ligamentum posticum scapulæ stretches across the semilunar notch of the scapula, forming it into a foramen.

FRACTURES OF THE SCAPULA. These are not very common, because of the mobility of the bone, and its being covered with muscle; yet the processes are more liable, and suffer this accident not unfrequently. The acromion may be broken: here the symptoms are an unusual declension of the shoulder, with an evident crepitus when the arm is raised. The treatment is to raise the arm and keep it so by binding it to the side. In fractures of the base or body, very little if any dislocation of the fractured part takes place, the muscles being a natural support. In fractures of the neck, the arm falls as in a dislocation, it must therefore be supported and bound to the chest while a pad is placed in the axilla. When the lower angle is

fractured, the shoulder must be depressed to meet the broken portion, under which a compress and bandage must be put. When the coracoid process suffers that injury, the muscles arising from it must be relaxed, the arm must be flexed upon the breast, and confined there with a compress and bandage, under the dislocated extremity of the bone.

OS HUMERI.

This bone constitutes the sole support of the arm, and enters into the formation of the shoulder and elbow joints. It is of a cylindrical form; and expanded into processes at its extremities, for the purposes of articulation, and the implantation of muscles.

It is divided into the HEAD, SHAFT, and EXTREMITY.

PROCESSES, etc. The *head* is a round semi-articular surface, covered with articular cartilage, situated on the most superior and internal part of the bone; it supplies the ball to the shoulder joint.

The *cervix* is a circular, narrow, rough groove, indented and perforated by small foraminulæ, placed at the circumference of the articular surface for the attachment of the capsular ligament.

Tubercula major. A large protuberance, situated on the outer and posterior part of the head* of the bone; having three oblique surfaces upon it, which are formed for the insertion of three muscles from the scapula: one levator of the arm, supra

* The *surgical* head of the bone is here understood.

spinatus, inserted on the uppermost; one abductor and rotator outwards, the infra-spinatus, inserted upon the middle; and one extensor, the teres minor, inserted upon the lowest of the three surfaces.

Tubercula minor. The lesser tubercle is situated at the anterior part of the surgical head; and is altogether occupied with the insertion of the abductor and rotator inwards, the subscapularis.

Fossa bicipitalis. The bicipital groove is that furrow which separates the two tubercles; it is continued down for a short space along the superior and outer part of the upper third of the humerus, and is insensibly lost. It contains the tendinous long head of the biceps flexor cubiti. On either side of it below the tubercles, are to be seen two elevated margins, thus named :—

Margo pectoralis. This extends downwards on the outer side of the bicipital groove, from the greater tubercle, and becomes insensibly lost with the extremity of the groove. It gives insertion to one of the flexors of the arm, the pectoralis major.

Margo lato-teres. This extends downwards on the inner side of the bicipital groove, from the lesser tubercle, and is also insensibly lost with the groove itself. It gives insertion to the primary depressors of the arm, the latissimus dorsi, and teres major muscles.

Observe the difference between the surgical head and neck, and the anatomical. In surgery the head comprizes the anatomical head and neck, properly so called, and the tubercles, while the neck is considered to be that part which forms the

link of connection betwixt them and the shaft, and which is here very much contracted; whereas the anatomical head is merely the articular surface, and the neck the narrow fosse for the attachment of the capsule.

Shaft. One of the greatest peculiarities of the shaft is its twisted form, as though, when soft and semiosseous, the muscles by their action had affected it. At its superior part it is somewhat circular, at its middle it is angular, and gradually towards its lower part it assumes a flattened extended form. On it are several points worthy of mention.

Processus deltoïdes. This is a rough angular elevation, on the outer and anterior side of the upper part (of the middle third) of the humerus, for the insertion of the deltoid muscle.

On either side of this process are two flat surfaces, for the origin of the bifid head of the brachialis internus muscle.

Sulcus spiralis. This is a groove, extending obliquely downwards and outwards, along the internal and posterior part of the middle third of the bone, formed between a surface above for the origin of the long head of the triceps, and another below for the shortest head of the triceps or brachialis externus. This groove is made by the spiral nerve, and ramus profundus magnus of the brachial artery; which both recede from the main continuations of the nervous and arterial trunks, which are found descending longitudinally on the inner side of the arm, overlapped by the biceps muscle; and dip downwards and backwards between the long and

short heads of the triceps, and therein form upon the bone the sulcus spiralis.

Canalis medullaris. This is an oblique canal, entering the middle third of the shaft of the bone, at its internal and anterior part; it transmits the medullary vessels to the anterior.

The *lower part* of the shaft is expanded so as to present an anterior convex, and a posterior flattened surface; and by its gradually widening, it gives a greater extent of surface to its extremity, which enters into the formation of the elbow joint. The processes of the lower third of the bone, and of the extremity are:—

The two *condyloid processes.*

The *external condyle* is the smallest of the two; and has an *inferior* surface of an orbicular form, covered with articular cartilage, which is opposed to the head of the radius; and an *external* rough surface, giving origin to the whole of the supinator radii brevis; and a *posterior* rough surface, giving origin to the extensor muscles of the wrist, extensor carpi radialis longior et brevior, and extensor carpi ulnaris; as well as to the anconeus and extensor digitorum communis.

The *internal condyle* is the largest, that is to say, its rough tubercle projects more than the external. But if a line be drawn equally across the centre of the joint, then the external will be found to give as much, if not more, surface to the articulation than the internal. The articular *inferior* surface of the internal condyle, is an oblique circular trochlea, having its internal edge elevated into a sharp ridge,

and being supplied with an internal perpendicular rough surface, which does not enter into the formation of the joint; while its external edge is similarly elevated, but to a less degree, into a circular ridge of bone, covered entirely with articular cartilage, and continuous with the articular surface of the external condyle, between which two it makes a natural division. This arrangement of the upper part of the elbow joint is important. The obliquity, caused by the internal part being lower than the external, gives to the hand, when flexed, a folding direction, by which it is carried upon the breast and not upon the arm, to do which considerable rotation of the shoulder joint must otherwise take place. The *internal* part of the internal condyle is a tubercle which gives origin to the flexor muscles of the wrist, and pronator radii teres. (Their order of origin and names are, pronator radii teres, flexor carpi radialis, palmaris longus, flexor carpi ulnaris, and flexor sublimis perforatus.)

External spine, is a ridge extending downwards along the outer part of the inferior third of the bone to the external condyle, where it ends. It gives attachment to the external intermuscular ligament; which is, in fact, merely a process of ligamentous substance substituted for bone, extending from the insertion of the deltoid muscle downwards between the brachialis internus and triceps exterior brevissimus, or brachialis externus, separating them, giving origin to the supinator radii longus, and having enveloped in its substance the continuations and inosculation of the ramus profundus

magnus arteriæ brachialis, and ramus recurrens arteriæ radialis, the one descending in the sulcus spiralis, the other ascending before the elbow joint and external condyle; as well as the continuation of the spiral nerve,—recollect this.

Internal spine. A mere line, seen however to be continuous, more or less distinctly in different subjects, with the margo-lato-teres, and consequently considerably longer, although less prominent than the external spine. It also gives attachment to the internal intermuscular ligament, which is a similar process of ligamentous substance as that before described, extending from the insertion of the coraco-brachialis to the internal condyle; it gives origin to part of the triceps extensor brevissimus, and brachialis internus; and has in its substance the inosculation of the profundus minor and anastomodic branches of the brachial artery, with the ulnar recurrent.

Two FOSSÆ. *Fossa coronoidea,* is a small angular cavity on the anterior surface of the extremity of the bone between the two condyles, and above the articular trochlea. It is not included within the capsule, but is implicated in the formation of the joint, and in flexion of the forearm, receives the coronoid process of the ulna. It contains synovial substance.

Fossa anconoidea, is a large oval depression, situated at the posterior part of the inferior extremity of the bone, between the two condyles, and above the articular surface of the joint. It is also connected with the joint, but not included in the

capsule, but receives in extension of the fore-arm, the anconoid process, or olecranon of the ulna; and likewise contains synovial substance. The bone between these two hollows is exceedingly thin, and in old persons almost transparent.

Sulcus cubitalis. This is a groove distinctly perceptible at the root of the inarticular internal condyle. It is formed by the cubital nerve, which is situated here just before it passes into the fore-arm.

Fœtal state. In the fœtus the extremities of the bone are cartilaginous, and at a subsequent period, by the process of ossification, the head, with the greater and less tubercles, and the condyles with their articular surfaces, become epiphyses; during the period of youth, these epiphyses early unite with the shaft into an osseous continuity.

Articulations. Superiorly, with the scapula in a ball and socket joint: inferiorly, with the radius and ulna in a compound ginglemus joint.

THE SHOULDER JOINT.

The *articular* surfaces of the shoulder joint are the head of the humerus, and the glenoid cavity of the scapula, by which, and the capsular ligament, this is constituted a ball and socket joint.

Capsular ligament. This is a spacious firm texture, attached, internally, to the circumference of the glenoid cavity of the scapula; and, externally, to the circumference of the articular ball of the humerus, or to the anatomical neck of the bone. It is perforated at the most external part of its

attachment to the humerus, to give egress to the long head of the biceps, which arises within the thick part of the capsule, but *not within the joint*, as some affirm, (for it is separated from it by a thin synovial sheath—the theca bicipitis, which is a continuation of the inner lamina of the capsule.)

There is no other ligament to this joint, but this is surrounded by so many organs that its strength is maintained as well as its mobility, which could not be the case if its braces were ligamentous. In the first place, we have the acromion process of the scapula, the scapular extremities of the clavicle, and the ligamentum triangulare scapulæ, giving an osseous and ligamentous bulwark to its superior part: the coracoid process upon its internal side; and the thickness of the deltoid muscle covering it extensively on its superior and external parts: then we have the tendon of the subscapularis, passing over, and thickening with a process of its substance, the anterior part of the shoulder joint: more superiorly and posteriorly in like manner the supra-spinatus; more posteriorly the infra-spinatus; and lastly, the teres minor; the tendons of each of which closely envelop and thicken the capsule, and form a moveable support, together with the tendon of the long head of the biceps, before mentioned.

DISLOCATIONS, FRACTURES, ETC. OF THE HUMERUS.

In a ratio to the extent of latitude of motion allowed to a joint, so will be its liability to dislocation, and the diversified derangement of position of the

dislocated part. Thus we have seen in the hip joint, which is an extensive one, that many varieties of luxation occur; so is it with the shoulder joint, and even more remarkably, and much more frequently. So numerous are dislocations of the shoulder joint, that they occur to as great an extent as to equal, in point of number, all the other dislocations of the bones of the skeleton at large, which might take place in any given period of time. Every circumstance in connection with this joint seems, on superficial inspection, to afford facility to dislocation; the shallowness of the socket, the largeness of the ball, the mobility of the arm, the paucity of ligaments, the thinness and looseness of the capsule, and at the lower part, the non-resistance of any organ; and lastly, the strength of the muscles, which when acting, for instance, spasmodically or to an undue extent, actually protrude the head against the opposite part of the capsule: all these seem very influential predisposing causes, rendering the arm liable to dislocation, whenever any slight exciting causes should take effect. But then we must cast into the opposite scale of our judgment these other considerations, which plainly convince us that the protection of this joint has not been neglected; namely, the mobility of the scapula itself, by which the joint is made to yield to force, and not to hazard an unsuccessful resistance; the bulwark, before mentioned, of the acromion, clavicle, and ligamentum triangulare, preventing completely a direct dislocation upwards; thirdly, the close embrace of the tendons of the scapular

muscles, each of which being a contracting organ, does by its own power and capacity retain the head of the bone against its socket, and by its elasticity, yield to the operation of flexion or extension by a passive consent to the action of the muscle immediately antagonizing; and lastly, by the influence of those other muscles of the arm which exert their active contracting capabilities on the lower part of the scapular extremity of the bone at a greater distance from the seat of motion; viz. the deltoïdes above, the pectoralis major anteriorly, and the latissimus dorsi, and teres major, posteriorly; all as it were antagonizing each other, yet producing, by their combined operation, a moveable yet firm support to the shoulder joint. To the *predisposing cause* of dislocation of the shoulder joint we have mentioned before, we will merely add paralysis of the deltoïd, and relaxation of the capsule, and scapular muscles, as belonging to that immediate class.

The exciting concurrent causes (for there is no such thing as a *single* cause, except it be the great *First Cause*,) are, the external force applied to the hand, elbow, or arm, the position of the limb, and the arrest of the shock communicated from the head by the capsule of the joint; so much for the mere external violence and its method of producing its effect. But there is another and more important exciting cause arising from active contraction of the muscles; the instinctive exertion of whose powers is found to produce the accident they are intended to prevent. Let us suppose, for instance, that a man

is falling from some scaffolding over the mouth of a well; he extends his arms as he falls so as to bring them over its mouth, and thereby attempts to keep himself suspended thereon; but the impetus of his fall is too great for his arms to resist, they are therefore obliged to yield as he enters the top of the well, and a new direction is given to them by the hands becoming elevated, and the head of the humerus being opposed to the axillary region; at this time the deltoïd contract instinctively with the pectoralis, the teres major, the latissimus dorsi, and the scapular muscles, with an intention of fixing the head of the bone against the glenoid cavity, and thereby allowing the force to be transmitted to the moveable scapula, which cannot be dislocated; but instead of the head of the bone being opposed to the scapula, it is resting against the thin axillary portion of the capsule, which can afford no resistance to the muscular contraction, and therefore a dislocation downwards into the axilla is the consequence. Although, however, we are obliged to describe this as an accident of degrees, yet both the force from without, and the resistance by the muscles, are consentaneous in their action and effects.

Varieties of dislocations. There is however a difference of liability to dislocation at various points of the shoulder joint. The head of the humerus cannot be dislocated upwards primarily, because of the resistance of the acromion, the clavicle, and the ligament. But at other points of the socket, that is to say, downwards, forwards, and

backwards, there are no such barriers, and therefore these are the points where dislocation may occur.

A dislocation is called *primitive*, when the head of the bone retains the position which it assumed when first protruded from the capsule. Primitive dislocation may take place, downward into the axilla; forward behind the pectoralis major; and outward or backward beneath the spine of the scapula.

A dislocation is called *consecutive*, when from any cause, such as a fresh fall or blow, much unskilful manipulation, or muscular contraction, the bone alters its position without the capsule. Thus a primary dislocation downwards may, by the action of the deltoid and pectoralis, become a consecutive one upwards and inwards; or if an empiric should attempt to reduce the same, a consecutive dislocation inwards may be the consequence. Now observe two things in reference to a consecutive dislocation. 1st. That the capsule must be lacerated, whereas it is not invariably or necessarily so in a primary; and 2dly. That this is a more difficult dislocation to reduce than a primary, because the laceration of the capsule is at the point of its first luxation, at a distance from the position of the head of the bone: and therefore it is essential that the surgeon should make himself perfectly acquainted with the history of his case, that he might bring the head to that part of the joint from which it was protruded before he uses the means of apposition.

Symptoms. To acquire an accurate knowledge of the symptoms of the various dislocations, it is necessary to become acquainted with certain circumstances common to all, and then with the peculiarities belonging to each.

In every dislocation of the humerus, an unnatural depression exists below the acromion, a point of the joint that is always prominent and full, by which that process of bone is made to project more than naturally; all the motions of the arm that are capable of being made, are limited in extent, as well from the situation of the head as the effort of the patient to retain it in a fixed position, they likewise cause very great pain when attempted; the patient supports his arm, brings forward his shoulder, and bends his trunk towards the affected side. In addition to these may be enumerated those symptoms, which point out the peculiarities of each dislocation.

Downwards: the arm is rather longer than in the natural state; it is capable of a little outward motion, but forward or backward motion causes extreme pain; the elbow is thrown outwards, and an angle is made with the body by the arm, in consequence of the contraction of the muscles above the joint. The patient is seen also to incline towards the side of the accident, that he may rest his elbow upon his hip, and prevent motion, the cause of increased pain, and keep the head of the bone from pressing upon the vessels and nerves in the axilla, whereinto it is protruded, and where it may be felt.

Inwards or *forwards:* in addition to the general symptoms, may be seen, a separation of the arm from the body, and a throwing backwards of the elbow; a protuberance beneath the pectoralis major, caused by the head of the bone; but not much difference in the length of the arm.

Backwards or *outwards:* this is known by a hard tumor presenting itself under the spine of the scapula, upon the inferior spinated fossa, and beneath the belly of the infra-spinatus muscle; the elbow will be thrown outwards and forwards, and a little downwards; and the arm will be to a small extent increased in length.

Reduction. When the dislocation is downwards, then the bone may be restored by placing the left hand under the axilla and depressing the humerus, using it as a lever; elevating the head at the same time, so that it may be pushed into its place. Or the patient being laid in a recumbent posture on a table or sofa, near its edge, the surgeon binds a wetted towel immediately above the elbow, upon which he ties a handkerchief; then with one foot resting upon the floor, he separates the patient's elbow from his side, and places the heel of his other foot in the axilla; and steadily drawing the arm, by means of the handkerchief, outwards, with more or less force, the head regains its proper position.

When the luxation is inwards, extend the humerus in the outer direction, into which it is thrown; then make it to describe a segment of a circle, so as to appose the head directly towards the glenoid cavity, that is, upwards and outwards.

The same holds good in reference to a dislocation backwards and outwards, only reversing the direction of the head after the extension, *i. e.* forwards, upwards, and inwards.

In these cases, the extending force may be modified to meet the necessities of the case, from a towel to the pulleys; and if any great opposition is experienced in consequence of muscular action, or the age of the dislocation, bleed in the one case, and use extensive power in the other, moving the arm about to destroy cellular adhesions, and employing stronger mechanical agency.

Fracture. This may be either transverse, oblique, or longitudinal, although the latter is denied by many: it may occur at any point of the bone, at its head, its shaft, or extremity.

Fractures of the humerus are generally attended with deformity; those of the upper third, above the insertion of the deltoid, will have that muscle as the chief agent in displacement; those near the extremity, will be less likely to be displaced by reason of the brachiales muscles forming natural bands, closely enveloping the bone on both sides. Fractures of the neck, and oblique ones of the middle third, are invariably attended with displacement. From this and other symptoms, the diagnosis is very evident.

Treatment. In fractures of the shaft, after a perfect apposition of the displaced bone, pass a short roller bandage around the arm, or a piece of flannel; then fix three splints to the inner, outer, and posterior sides of the arm, making the outer

of a length to reach below the elbow. These must be secured by another roller, sufficiently tight, and the forearm supported in a sling.

Fractures of the neck, or that is to say, of the narrow portion of the bone below the head and tubercles, being coapted by extension, etc., the surgeon has to employ an apparatus to prevent motion, and to keep the shaft and head in right bearing with each other. Let the assistant still keep the limb moderately extended, while the surgeon, having previously made his roller bandage wet in spirituous lotion, fixes it, at its lower end, around the thickness of the forearm; and thence continues to bind round the arm from below upwards, making every turn to overlap the preceding, and manœuvering, to prevent creases where the thickness of the arm is variable. He is now to pass it twice across the trunk and under the axilla of the opposite arm, until it reaches the top of the shoulder, where its remaining portion must be retained by an assistant. He now places the splints; one in front, extending from the elbow-joint to the end of the clavicle; the second from the outer condyle to the acromion; the third, posteriorly, from the under edge of the teres major to the olecranon. These are retained in their position by an assistant at their lower part, while the surgeon brings the bandage down over the splints, to keep them together; a thick compress or pillow is now to be put into the axilla and fixed there, by pins, to the roller. Now the arm is to be approximated to the chest and bound up on the pillow by a roller passed around

it and the thorax; and lastly, the forearm must be placed in a sling.

A case of *longitudinal* splitting of the head has occurred in the practice of Mr. GUTHRIE; another case in Westminster hospital, was lately subject of dispute between that surgeon, who maintained that it was longitudinal fracture, and Mr. LYNN, who considered it separation of the epiphyses.

The bones of the fore-arm are, the ULNA, situated most inwardly; and the RADIUS, outwardly.

ULNA.

This bone is situated at the inner side of the forearm, and is constituted of three parts, viz. two extremities and a shaft.

The *superior extremity* is called the HEAD, and forms the thickest part of the bone, and that which is in coaptation with the inner condyle of the humerus. Observe on it the following processes and parts.

1. *Processus anconeus* or *olecranon*, curved and thick, and constituting the superiormost part of the bone: its anterior surface is articular, its posterior rough, and its apex pitted for the insertion of the triceps extensor cubiti.

2. *Coronoid process.* This process is smaller, and placed on the superior and anterior part of the head, below and in front of the latter. It is sharp, and is for the perfecting of the hinge of the joint. This process is received, in flexion, into the fossa coronoidea of the humerus; and the olecranon into the fossa anconoidea in the act of extension.

3. The *great sigmoid cavity*. Semilunar in form and articular, is constituted, on the superior part of the head, by the superior surfaces of the olecranoid and coronoid processes. This cavity is in adaptation to two inner thirds of the articulating trochlea of the humerus, and consequently it is divided in the centre into two inclined surfaces, by a raphe, which is opposed to the sulcus seen in the articulation of the humerus.

4. The *lesser sigmoid cavity*, also semilunar and articular, is very small in comparison with the former. It is situated at the outer side of the head of the ulna, at the root of the coronoid process. This forms for the head of the radius a trochlea, which is furnished with a tubercle before and behind, for the attachments of an orbicular ligament encircling that bone.

5. The *tubercle*, situated at the under side of the root of the coronoid process, is rough and elevated to give insertion to the brachialis internus.

6. An inclined plane upon the superior and external side of the head, for the lodgment of the anconeus.

The SHAFT is triangular, somewhat broad near the head, and gradually narrowing and becoming rounder towards its end. Observe upon it three spines, and three surfaces.

1. The *external* angle or spine, is the shortest, and extends throughout the whole length of the bone. It is opposed to the radius, and gives attachment to the interosseous ligament.

2. The *anterior* spine, extends from the tubercle

along the inner and anterior side of the bone, in a rounded form; it serves to divide the anterior and internal surfaces. At its lower third, it becomes suddenly bold and prominent, to give origin to the pronator quadratus.

3. The *posterior* spine extends from the olecranon in a waved form along the back of the bone, being lost towards the lower third; it is sharp, and divides the posterior and internal surfaces: at its upper part it gives insertion to the anconeus, and below, origin to the extensor carpi ulnaris.

4. The *anterior surface* is somewhat flat and inclined towards the external spine, so as to form half of a concavity, completed by the interosseous ligament and the radius: it gives origin to the flexor profundus perforans, and at its lower third is covered by the pronator quadratus.

5. The *internal* surface, between the anterior and posterior spines, gives origin to the flexor profundus at its upper part; and at its lower third is unoccupied with the attachment of muscles.

6. The *posterior* surface at its upper part, gives origin to part of the extensor carpi ulnaris and insertion to the anconeus: at its middle third, origin to the extensor ossis metacarpi pollicis, extensores primi et secundi internodii, and indicator: and at its lower part it has no muscular attachments.

7. The canalis medullaris, is seen on the anterior surface, slanting upwards.

The INFERIOR EXTREMITY is somewhat circular, and very small. Observe upon it,

1. The *styloid* process, a prolongation of bone

from the inner and posterior part; it gives attachment to the interarticular cartilage, internal lateral ligament of the wrist, and carpi annulare.

2. The circular button has *two articulations:* one inferiorly, to form part of the wrist joint; and one laterally and externally, to join with the extremity of the radius.

3. A *sulcus* behind the styloid process, for the tendon of the extensor carpi ulnaris.

In the fœtus the shaft is ossified, having cartilaginous extremities, which soon become epiphyses.

RADIUS.

This bone, situated at the outer side of the forearm, in contradistinction from the ulna, is smallest at its upper, and largest at its lower extremity. It takes its name from its describing the segment of a circle in its motion around the ulna. Divide it into shaft and two extremities.

The SUPERIOR EXTREMITY possesses the following parts:—

1. *Head*, a button-shaped, circular, articulating process; concave superiorly, to fit the round end of the humerus; and convex laterally, to roll in the lesser sigmoid cavity of the ulna.

2. The *cervix*, a distinct, narrow neck, connecting the head with the shaft, and surrounded by the orbicular ligament.

3. The *tubercle*, situated below the neck at the inner part of the bone, is a prominent process, giving insertion to the biceps flexor cubiti.

The SHAFT or body of the bone, is, like the ulna, divided into three spines and three surfaces.

1. The *internal* spine, which is sharp, gives attachment to the interosseous ligament.

2. The *external* spine commences below the tubercle, and between the anterior and external surfaces. It is sharp at its upper third, to give origin to the flexor sublimis perforatus; obtuse, and almost lost at its middle; and sharp again at its lower end, giving insertion to the supinator radii longus, and pronator quadratus; it terminates in the spinous process.

3. The *posterior* spine is ill-defined; its most prominent part is at its middle third, where it is confounded with a rough eminence on the outer side of the shaft, called *processus rotundus*, for the insertion of the pronator radii teres.

4. The *anterior* surface, below the tubercle, and between the inner and outer spines, is concave, giving origin to part of the flex. sublimis perf. and f. longus pollicis. The pronator quadratus crosses its lower part.

5. The *external* surface is rounded, and covered by the supernator radii longus, et brevis, and extensor carpi radialis longior, et brevior; it possesses the p. rotundus at its middle third for the pronator r. teres.

6. The *posterior* surface is irregularly flat, giving origin to the extensor ossis metacarpi pollicis. At its lower third it is covered by the extensor tendons of the thumb, (indicator,) fingers, and hand.

The LOWER EXTREMITY is the thickest portion of the bone, which possesses the following parts worthy of mention.

1. The *large scaphoid* cavity, constituting its extreme articular hollow, forming the major part of the notch for the carpus, which is completed by interarticular cartilage.

2. The *small scaphoid* cavity, situated at the inner side of the bone, also articular, and receiving the circular extremity of the ulna.

3. The *styloid* process, at the outer side of the extremity; a point of bone eking downwards, so as to deepen the concavity of the articular socket, and give attachment to ligaments; at its root is inserted the supinator radii longus.

4. In the *posterior* side of the extremity are numerous sulci, formed for the passage of the extensor tendons. Their order from without inwards, is as follows:—most outwardly, ext. ossis metacarpi, and primi internodii; then, more inwardly, a sulcus, for the ext. carpi radialis longior, et brevior; still more inwardly, a small one for the secundi internodii; and most inwardly, a large one, divided into two, for the indicator and extensor communis digitorum.

This bone, in the fœtus, is in three parts, of which the head and extremity are epiphyses to the shaft.

THE ELBOW JOINT.

The surfaces of the elbow joint are the articular condyles of the os humeri, superiorly; the great sigmoid flexure of the ulna, inferiorly and internally; and the lesser sigmoid cavity of the ulna, with the round head of the radius, revolving in it, inferiorly and externally. The ligaments are strong.

The *ligamentum capsulare*. This is two-fold, viz. an internal synovial membrane, and an external condensed structure. It is attached, superiorly, to the circumference of the articular surfaces of the condyles of the humerus, so loosely as to permit flexion and extension of the arm without stretching; excluding the synovial masses in the fossæ, yet permitting the inner membrane of the capsule to be carried into them, and these masses to be compressed by the processes of the ulna. It is attached, inferiorly and internally, to the sharp margins of the coronoid and anconoid processes, around the greater and sigmoid cavity of the ulna, and to the circumference of the lesser sigmoid cavity, externally and inferiorly.

The head of the radius is inclosed within the joint by the outer lamina of the capsule becoming increased into a circle of thick ligamentous substance, passing around the neck, and having attachments, anteriorly and posteriorly, to the articular surfaces of the lesser sigmoid cavity, to tubercles upon the outer side of the ulna. The thin synovial membrane of course is reflected over the head: the outer ligamentous band encircling the neck, called *ligamentum orbiculare*, is described as not attached to the radius at all: but there is of course still to be seen an extenuated continuation of fibre, which is lost upon the tubercle and upper part of the shaft.

The *ligamentum laterale externum*, is a fasciculus of strong fibres, strengthening the outer side of the joint; it is attached, superiorly, to the external condyle; and, inferiorly, is lost upon the orbicular or coronary ligament just described.

The *lig. later. internum* in like manner spreads upon the inner side of the joint; is attached above, to the inner condyle; and, inferiorly, is lost in a fan shape upon the inner flat side of the ulna, between the anconoid and coronoid processes.

The *lig. interosseum*, is a membrane, expanded between the outer spine of the ulna and inner spine of the radius; it is imperfect above, and gives origin to muscles; to the description of which it chiefly belongs.

DISLOCATIONS AND FRACTURES OF THE FOREARM.

Dislocation of the elbow joint may occur in four directions, viz. *laterally*, where it is necessarily imperfect; *backwards*, where it is perfect; or *forwards*, which is very rare, and requires a fracture of the olecranon. In addition to these cases, wherein both bones are consentaneously luxated, there are others where the upper part of the radius is projected forwards or backwards from the outer condyle of the humerus, or the ulna carried backwards from the inner condyle. Now these accidents are easily ascertained, even if considerable swelling has accrued; and although they may be irreducible from that cause at an early period after the occurrence of the accident, yet, being a ginglemoid joint, less danger is risked in deferring, and less difficulty experienced in the attempts at reduction at a later period, than in a ball and socket joint. It is evident that no luxation can affect this joint without serious injury to the soft parts, and especially to the ligaments; the laterals must be of

necessity ruptured, and in dislocation of the radius, the orbicular also. Luxation backwards, too, must present not a little difficulty in the reduction, from the power given to the triceps extensor muscles, while the nerves and arterial trunks in the bend of the forearm must be racked upon the swollen brachialis internus. To reduce this, the patient must be seated in the lap of an assistant, who takes firm hold of the humerus about its middle, and fixes it; another assistant, holding the wrist, extends the forearm in the direction in which it is cast; while the surgeon, with both his hands, kneads the upper parts of the bones of the forearm into apposition with the extremity of the humerus. Dislocation forwards must be treated as fracture of the olecranon, which must accompany it. Copious bleeding and antiphlogistic measures, with coaptation of the fractured portion by means of a bandage around the lower part of the humerus, are necessary, because the triceps draws up the apophysis from the shaft. A straight position of the arm is best for this accident. Dislocation *laterally* is partial and easily discoverable; forcible extension easily replaces the luxated bones, by the agency of the flexor and extensor muscles. Dislocation of the radius, requires a flexed position after the reduction. In all these cases, except, perhaps, that with fracture of the olecranon, gentle motion should be made after the lapse of a few days, to prevent stiffness.

Fracture may occur either to one bone or to both, or it may separate the epiphyses such as the

olecranon, the head of the radius, or the extremities of these bones.

Fracture of both bones is the result of violence inflicted on the forearm, and seldom from the shock of a fall on the hand, which is transmitted to the clavicle. They generally occur at the middle or lower part of the forearm, and both bones suffer the injury in the same part, or the fracture extends on a line through both. Here the symptoms are very evident, although displacement is to a very trifling extent, by reason of the attachment of the interosseous ligament. The forearm must be bent to a right angle with the arm, and extension made by the fingers; then two pads are to be applied to the front and back part of the forearm, which are to be thickest at the wrist, and thinnest near the elbow, in order thereby to equalize the surfaces: a roller is then to be carried around the arm to promote this design still more accurately, and to keep the compresses in their place: and upon this two splints, one in front of, the other behind, the forearm, and bound there by a second roller: lastly, the forearm must be supported at right angles with the arm, and in a prone direction, by means of a sling.

Fractures of individual bones require no extension; and indeed no other treatment but a soap plaster, a prone direction, and support by a sling.

Fracture of the olecranon must be treated on the same principle as that of the patella. Great discussion has arisen as to whether it be better to place the forearm in a state of perfect extension or slightly to flex it; but surely the nature of the accident and

experience will at once decide, that the nearer the parts are approximated, the more chance they have to unite, and numerous cases have repeatedly proved that ligamentous union only takes place under a different mode of procedure.

I have never seen but one case of fracture of the neck of the radius, which was however evident enough, for while there was ability to rotate the hand, a crepitus was felt at the elbow joint. This was treated by placing the forearm in a flexed and prone state, and pieces of pasteboard (previously made wet) were moulded to the joint, laterally, a bandage being carried over the whole; with support by a sling.

THE HAND.

The hand is divided into three sets of bones, viz. the carpus, metacarpus, and phalanges.

CARPUS.

This is composed of eight bones, arranged in two series, or four in a row. They are as follow, ossa scaphoides, lunare, cuneiforme, pisiforme, (first row); and trapezium, trapezoides, magnum, and unciforme, (second row). These, in their connected state, form an arch in a lateral direction, the convexity of which is on the dorsum, and the concavity in the palm.

The OS SCAPHOIDES, the largest bone of the first row, and situated at the outer and superior part of the carpus, is navicular in its shape; possessing a superior convex articulating surface, forming part

of the ball of the wrist joint; an inferior convex articular surface, opposed to the ossa trapezium and trapezoides; an external scabrous surface; an internal, doubly concave, articular surface, opposed to the os lunare, and forming part of a socket for the magnum; an anterior rough, concave surface, forming part of the palm; and a posterior rough, convex surface, forming part of the dorsum.

Os LUNARE. Semilunar in form, is the second bone, more inwardly: it possesses a superior convex articular surface, forming part of the ball of the wrist joint; an inferior concave articular surface, forming the other part of the socket to the os magnum; an external surface, articular and concave, opposed to the scaphoides; an internal articular surface, opposed to the os cuneiforme; an anterior rough palmar; and a posterior convex, inarticular, dorsal surface.

Os CUNEIFORME, so called because it is inserted into the carpus like a wedge, is situated at the innermost side of the first row. It possesses a superior articular surface, opposed distantly to the extremity of the ulna, (but separated from it by the triangular cartilage); an inferior concave surface, opposed to the unciforme; an external articular surface, opposed to the lunare; an internal rough surface, slightly grooved; an anterior articular surface, connected with the pisiforme; a posterior rough surface on the arch of the dorsum.

Os PISIFORME, or subrotundum, is resembled to a split pea: it has an anterior tuberculous projection, which gives attachment to the lig. carpi annulare;

and a posterior articular surface, received upon the cuneiforme.

The OS TRAPEZIUM, the first bone of the second row, is situated at the root of the thumb. It possesses a superior concave articular surface, connected to the scaphoides; an inferior trochlea for the joint of the metacarpal bone of the thumb; an external rough surface; an internal articular surface, connected with the trapezoides; an anterior rough surface, on which is seen a groove, lodging the tendon of the flexor carpi radialis, and an eminence, giving origin to the lesser flexor muscles of the thumb, as well as attachment to the lig. carpi annulare; and a posterior trapezoid dorsal surface on the arch of the hand.

The OS TRAPEZOIDES, the second bone, and smallest of the second row, possesses a superior articulated surface, connected to the scaphoides; an inferior articular surface, connected to the base of the metacarpal bone of the index finger; an external articular surface, opposed to the trapezium; an internal, also articular, connected with the magnum and side of the base of the metacarpal bone of the middle finger; and dorsal and palmar rough surfaces.

The OS MAGNUM, or largest bone of the carpus, is the third of the second row. Its superior part, which is very properly termed the *head*, is a circular articular projection, lodged in the cavity formed by the scaphoides and lunare. Its inferior part is termed the *body;* and possesses an inferior angular surface, articulated with the base of the

metacarpal bone of the middle finger, and side of the base of that of the ring finger; an external articular surface, opposed to the trapezoides; an internal, also articular, opposed to the unciforme; beside a palmar, and a dorsal rough surface.

Os UNCIFORME, so called because it possesses an hooked process, is the most internal of the second row. It possesses a superior articular surface, opposed to the cuneiforme; an inferior, also articular, to the bases of the metacarpals of the ring and little fingers; an external, also articular, connected with the magnum; an internal, inarticular surface, on the margin of the hand; an anterior rough surface, projecting forwards to the *unciform process*, which gives origin to muscles, and attachment to the transverse or annular ligament; and a posterior rough surface, seen upon the dorsum.

These bones are all connected to each other by synovial capsules, over which pass strong binding ligaments. All these capsules communicate, with the exception of that of the pisiform bone, so that the whole forms a common joint. The fœtal bones are cartilaginous.

THE WRIST JOINT.

This is a compound joint, engaging the articulating surfaces of five bones, and an interarticular cartilage, and consequently possessing two capsules. Particularly observe the relation of the extremities of the bones of the forearm to each other, and to the carpus; and you perceive that the ulna has a somewhat similar shape to the head of

the radius; that the latter bone forms the major part of the socket for the hand; and that there is greater space between the extremity of the ulna and the os cuneiforme, than between the radius and the two other bones.

The *articular surfaces* of the *proper* wrist joint are, the greater scaphoid cavity of the radius, and the under surface of the interarticular cartilage, superiorly; and the upper surfaces of three of the first row of the carpal bones, inferiorly.

The *articulating surfaces* of the *accessary*, or joint between the radius and ulna, are, the extremity of the ulna, the lesser scaphoid cavity of the radius, and the interarticular cartilage.

Lig. capsulare proprium, is a strong synovial and ligamentous structure, attached, superiorly, to the circumference of the articular extremity of the ulna and the margin of the interarticular cartilage; and inferiorly, to the sides of the articulating surface of the three bones of the carpus.

The *interarticular cartilage*, is called triangular in shape, is thickest at its inner part, or where it is connected to the style of the ulna, and thinnest towards the radius; it is concave above, for the extremity of the ulna, and concave below, to form the socket of the wrist. Its property is elasticity.

Lig. capsulare sacciforme, engages the circumference of the extremity of the ulna, the margin of the lesser scaphoid cavity of the radius, and the circle of the interarticular cartilage.

Lig. lateralia ext. et int. The external is a bundle of fibres, attached superiorly to the style

of the radius; and descending, is implanted inferiorly on the os scaphoides: the internal is attached above, to the style of the ulna; and below to the ossa cuneiforme and pisiforme.

Lig. mucosum, seen in the joint, is a fold of the synovial membrane, duplicating from the interstice between the scaphoides and lunare into the cavity of the joint towards the scaphoid cavity of the radius to which it is attached; it confines synovial structure between its duplication.

The motion of the wrist is ginglemus.

LIGAMENTS OF THE CARPUS.

Beside the *capsular ligaments* in general, that between the lunare, scaphoides, and magnum, claims particular attention, inasmuch as it is loose and admits of considerable yielding motion.

Accessory palmar and *dorsal ligaments* strengthen these joints by their decussations, as seen in the tarsus.

Lig. carpi annulare anticum. This is a very strong and important ligament, forming a bridge, under which all the flexor tendons of the hand and fingers pass to their destination: it is composed of dense ligamentous substance; attached externally, to the ossa scaphoides and trapezium; and internally, to the pisiforme and unciforme. It is connected with the fascia palmaris, and tendon of the palmaris longus, by continuity of substance.

Lig. carpi annulare posticum, is a similar process of ligamentous substance, stretching from the style of the radius across the back of the capsule,

and over the extensor tendons, to the style of the ulna, another slip crosses the carpus lower down, which is, in fact, a condensed part of the dorsal fascia.

Dislocation of the wrist may be backwards or forwards; the latter is the most frequent. Lateral dislocations are of necessity imperfect, and, moreover, exceedingly rare. These are all easy of reduction soon after the accident, but the difficulty increases with its age, and after a short period it is irreducible. The chief mischief is to be apprehended from the violence done to the synovial and other structures producing inflammation and swelling. These must be attended to after the reduction, by keeping the arm in splints, and using sedative lotions, etc.

Dislocation of the end of the radius from the ulna must be treated by pushing the latter point forward and the radius backward into juxta-position with each other, or *vice versa*, as the radius is dislocated forward or backward.

METACARPUS.

There are five metacarpal bones, four of which supporting the fingers, possess little capability of motion, the fifth supporting the thumb, enjoys great latitude of motion, and bears a distinct resemblance to the phalanges.

The *general* characters of a metacarpal bone are, a large *head*, with an extensive articulating surface; a distinct *neck* for the capsular ligament; *tubercles* between that for the attachment of trans-

verse ligaments; a curved *shaft* convex on the dorsum, having *spines* and *surfaces;* and lastly, a *base*, procuring three articulating surfaces, two lateral, and a superior one.

PECULIARITIES OF THE INDIVIDUAL BONES. The metacarpal bone of the thumb is the shortest, and situated at an obliquity with respect to the others. It has a concave articulating surface, forming part of a free joint with the trapezium, and has no lateral connections; a tubercle for the attachment of the external lateral ligament; a short, thick shaft, flattened somewhat on the back, and concave anteriorly; and a head, possessing a trochlea superiorly, and two tubercles laterally, for the purposes of its articulation with the first phalanx. Very frequently there are subrotunda on the anterior side of the head of this bone. It gives insertion to the flexor and extensor ossis metacarpi, to the adductor and part of the flexor brevis, and to the abductor pollicis.

The metacarpal bone of the fore finger is largest, and most direct: that of the middle is a little shorter; and has a styloid process at its base, which is inserted between the os magnum and trapezoides. That of the ring finger is slight; and that of the little is the shortest of the four, and possesses no internal literal articulation; it has also an oblique basal articulation opposed to the os unciforme. This bone is allowed a little motion, and gives insertion to the abductor metacarpi, min. digiti.

The spaces between the metacarpals are occupied with the interossei, as in the foot.

PHALANGES.

These are fourteen in number, two to the thumb, and three to each of the fingers.

Their general characters comprehend a *base*, (the broadest part,) with a concave articular cavity for the heads of the metacarpals; a *shaft*, curved, convex posteriorly, and concave anteriorly, with two sharp spines laterally, for the attachment of the thecæ of the tendons; and a *head*, forming a trochlea, concave, and sulcated in the middle, for their articulation with the second row.

Of this phalanx, the bones of the thumb and little finger are usually of the same length, and shortest; the ring finger next; the fore still longer; and the middle finger the longest.

The *peculiar characters* of the second row are, their diminished size; and the double concavity and intermediate ridge of their basal articulation. The second bone of the thumb is like those of the third row.

The *peculiar characters* of the third row are, the prolongation of the bases forwards and backwards, so as to make a flexion around the heads of the second row; sets of tubercles at their sides, and rough tuberculated extremities for the implantation of the tendons. Sets of subrotunda are frequently found in connection with the extremities of the phalanges.

ARTICULATIONS OF THE METACARPUS AND PHALANGES. These are in many respects similar to those described as belonging to the metatarsals and toes: with, however, the peculiarity of the *cap-*

sules being stronger and looser, and admitting greater motion, in conformity with the altered direction of the articular surfaces and the different offices of the two organs. The *lateral* ligaments of the joints of the fingers are strong, and the transverse slips of the bases and heads of the metacarpals (called *interosseal* ligaments in the hand, and *transverse* in the foot) are distinct.

The articulation between the thumb and trapezium, merits particular attention. It possesses a *capsular* and two *lateral* ligaments, of great strength; the motion is ginglemus, like that of the fingers in general. Considerable difficulty is oftimes experienced in the reduction of this, when luxated. In many persons, by reason of the laxity of the capsule, the bone can be spontaneously dislocated. Dislocation of the phalanges presents no difficulty, either in the diagnosis or reduction; nevertheless, the same remark is applicable here as was made before, that there is an increase of difficulty correspondent with the age of the dislocation, so that after a short period, the luxation must become permanent.

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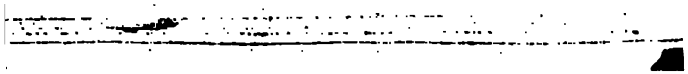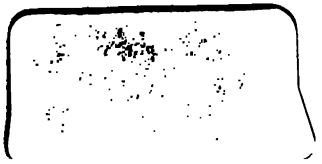
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